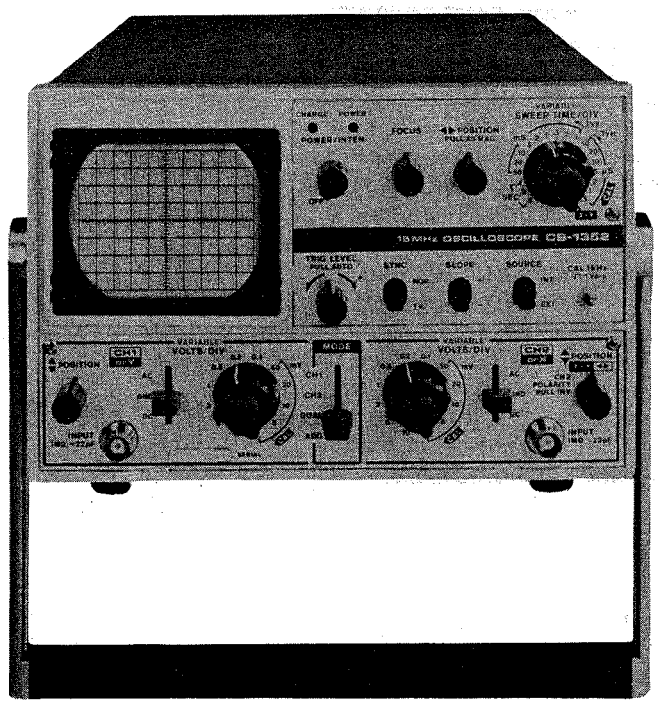
KENWOOD

DUAL TRACE OSCILLOSCOPE

CS-1352

SERVICE MANUAL

TRIO-KENWOOD CORPORATION



FEATURES

The model CS-1352 is a portable, dual trace oscilloscope with a 75 mm cathode ray tube. It operates on AC, DC or internal battery so that it can be used anywhere; power source selection is automatic.
The vertical axis features a wide band and high sensitivity (15 MHz, 2 mV/div), permitting observation of various types of signals.
The adoption of over-discharge protection circuit automatically shuts off the battery circuit when battery voltage is decreased, thus protecting the battery from over-discharge.
The oscilloscope incorporates a built-in battery charger to charge the internal battery even when the unit is in operation.

CONTENTS

FEATURES 1
SPECIFICATIONS 2
EXTERNAL VIEW AND NAME OF PARTS 4
CIRCUIT DESCRIPTIONS
BLOCK DIAGRAM 5
GENERAL 6
VERTICAL DEFLECTION CIRCUIT 6
VERTICAL MODE LOGIC AND TRIGGER SELECTION CIRCUIT 6
TRIGGERING CIRCUIT 7
HORIZONTAL CIRCUIT AND SYNC SWEEP CIRCUIT 7
BLANKING AND INTENSITY CIRCUITS 8
CALIBRATING VOLTAGE CIRCUIT 8
(1) AC RECTIFIER CIRCUIT 8
(2) CHARGER REGULATOR CIRCUIT 8
(3) LOW BATTERY VOLTAGE PROTECTION CIRCUIT 8
(4) AC DC BATTERY SELECT 8
(5) DC TO DC CONVERTER CIRCUIT 8
(6) LOW BATTERY FLASHER 8
MAINTENANCE AND ADJUSTMENT
MAINTENANCE 9
ADJUSTMENT 11
TROUBLESHOOTING 15
PC BOARD 21
PARTS LIST 28
SCHEMATIC DIAGRAM 37

SPECIFICATIONS

Type of Cathode Ray Tube C331P31B
Acceleration Voltage Approx. 1.5 kV

Vertical Axis (for both CH1 and CH2)

Sensitivity 2 mV/div ∿ 10 V/div, 1-2-5 step (1 div = 0.6 cm)
Precisely adjustable in all ranges
Sensitivity error between ranges is ±5%
Input Impedance 1 MΩ ±5%
Input Capacitance 22 pF ±3 pF
Frequency Response DC: DC-15 MHz
(less than −3 dB)
AC: 10 Hz-15 MHz
(less than −3 dB)
Rising Time Less than 23 nsec.
Over-shoot Less than 3% (at 100 kHz square wave)
Cross-talk Better than −70 dB at 1 kHz
Operating Mode
CH1: Channel 1 only
CH2: Channel 2 only
DUAL: 2-channel (CHOP and ALT are automatically selected by SWEEP TIME/DIV) 0.5 μs/ div ~ 0.5 ms/div:
ALT (alternate sweep) 1 ms/div ~ 0.5 s/div:
CHOP
ADD: 2-channel algebraic sum (CH1 + CH2)
Invert Polarity CH2 only
CHOP Frequency 200 kHz ±20%
Maximum Input Allowable Voltage 600 Vp-p or 300 V (DC + AC peak)

Sweep Circuit

Sweep System Triggering sweep and auto sweep (free-running sweep at no-signal time)
Sweep Time 0.5 μs/div ~ 0.5 s/div ±5% and "X - Y", 1-2-5 step Fine adjustment in all 19 ranges
Magnifier 5 times ±5%
(PULL × 5 MAG)
Linearity Less than 3%
(2 μ s/div ~ 0.5 s/div)
Less than 5%
(0.5 μs/div ~ 1 μs/div)

Synchronization

Sync Input
INT: Mode switch changeover, CH1 at DUAL
EXT
Sync Selection NOR: positive and negative
TV: positive and negative
(TVH and TVV are automatically switched by SWEEP TIME/DIV)
TVH (TV - Line):
0.5 μs/div ~ 50 μs/div
TVV (TV - Frame):
0.1 ms/div ~ 50 s/div

Sync Range

Sync Position	Sync Frequency	Min. sync voltage (amplitude)	
		INT	EXT
NOR	20 Hz ~ 5 MHz	0.5 div	0.5 Vp-p
	20 Hz ~ 10 MHz	1 div	0.5 Vp-p
	20 Hz ~ 15 MHz	1 div	1 Vp-p
(AUTO)	50 Hz ~ 15 MHz	1 div	1 Vp-p
TV	TV signal	1 div	1 Vp-p

External sync input voltage 50 V (DC + AC peak)

Horizontal Axis (CH2 input)

Operating Mode X-Y mode is selected by SWEEP TIME/DIV
CH1: Y axis
CH2: X axis
Sensitivity Same as CH2
(2 mV/div ~ 10V/div ±5%)
Frequency Response DC DC-1 MHz
(less than −3 dB)
AC 10 Hz-1 MHz
(less than −3 dB)
Input Impedance Same as CH2 (1 MΩ ±5%)
Input Capacitance Same as CH2
(22 pF ±3 pF)
Calibrating Voltage 1 Vp-p +3% positive, (1 kHz ±5% square wave)

Intensity Modulation

Input Voltage Lights at +5 V or less
Input Impedance 10 kΩ ±20%
Frequency Response DC ~ 1 MHz
Maximum Input Allowable Voltage 50 V (DC + AC peak)

SPECIFICATIONS

Power Source

AC

Power Supply Voltage	100/120/220/240 V ±10%, 50/60 Hz
Power Consumption	Approx. 25 W
Battery (Option)	
Power Supply Voltage	12 V
Continuous Operation Time	More than 2 hours with fully charged battery

DC

Power Supply Voltage	11 ~ 15.5 V
Power Consumption	Approx. 20 W
Charging	
Charging System	Internal battery is charged by connecting AC line cord
Charging Time	Charging during operation .....Approx. 28 H Charging only . Approx. 16 H
Ambient Temperature and Humidity	0 ~ 50°C, 95% or less

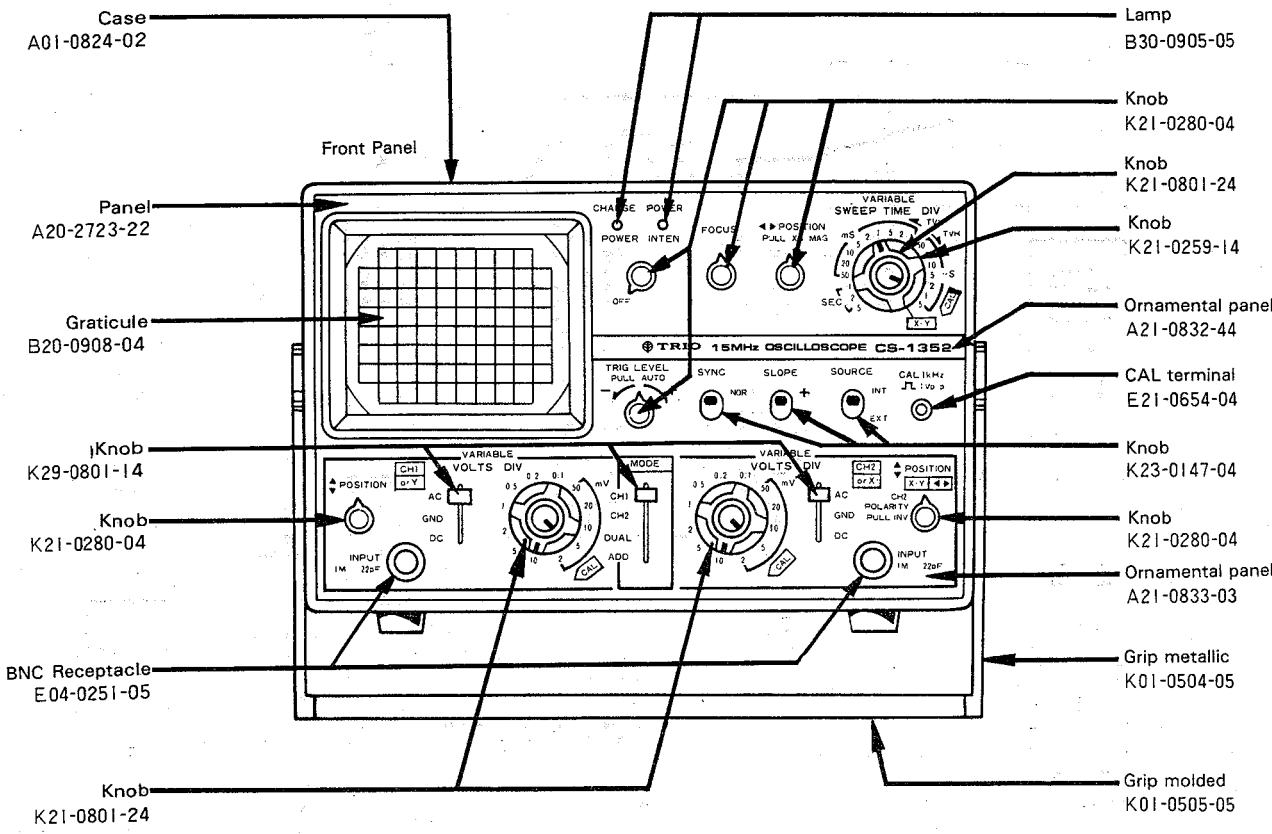
Dimensions and Weight

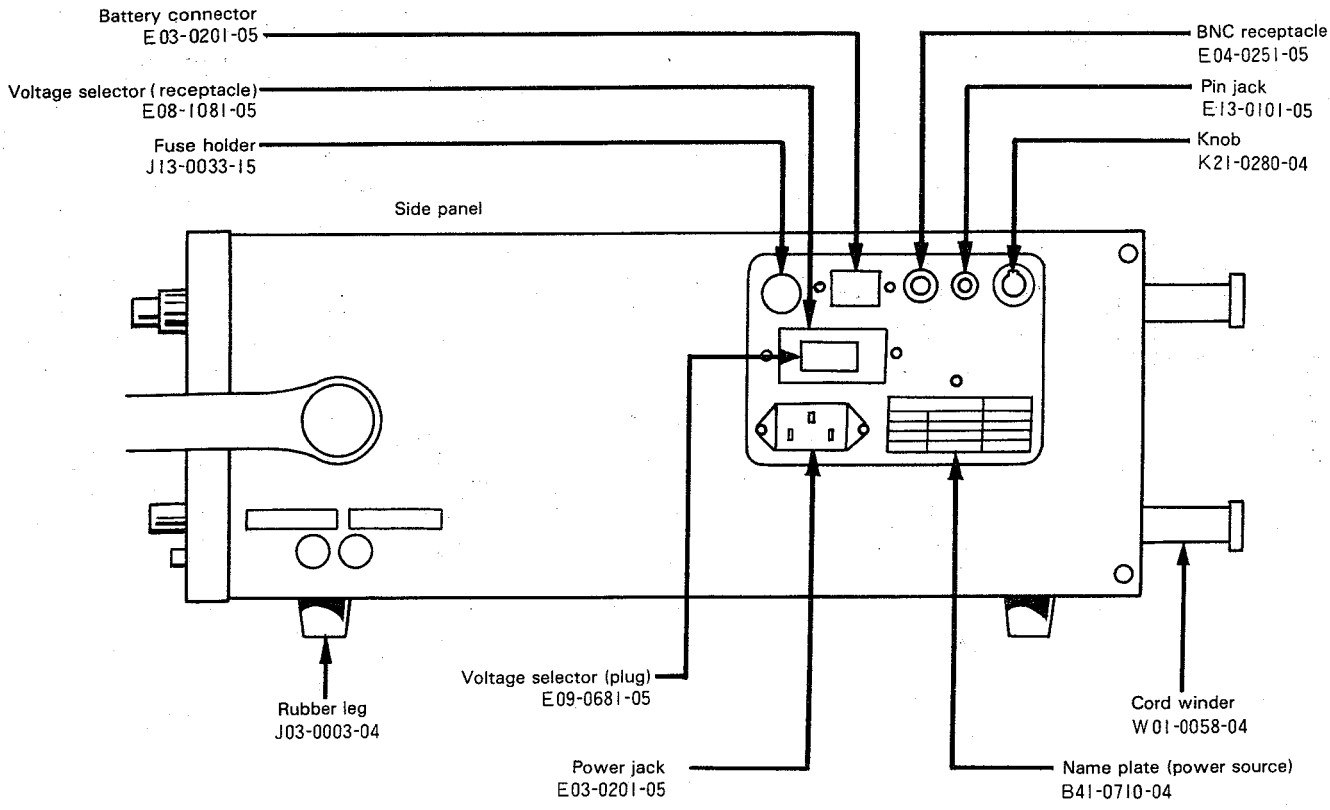
Width	210 mm
Height	136 mm
Depth	348 mm
Weight	6.5 kg (without battery) 8.3 kg (with battery)

Accessory

Probe	PC-29 .....2 Damping.....1/10 Input impedance .....10 MΩ Input capacitance .....less than 18 pF
Pin-plug	1
Replacement fuse	0.5 A.....2 1 A.....2
Hood (BF-6)	1
External power connector plug	1
Instruction Manual	1 copy
Optional accessories	Shoulder bag (MC-75) Battery pack (BP-7E)

EXTERNAL VIEW AND NAME OF PARTS





BLOCK DIAGRAM

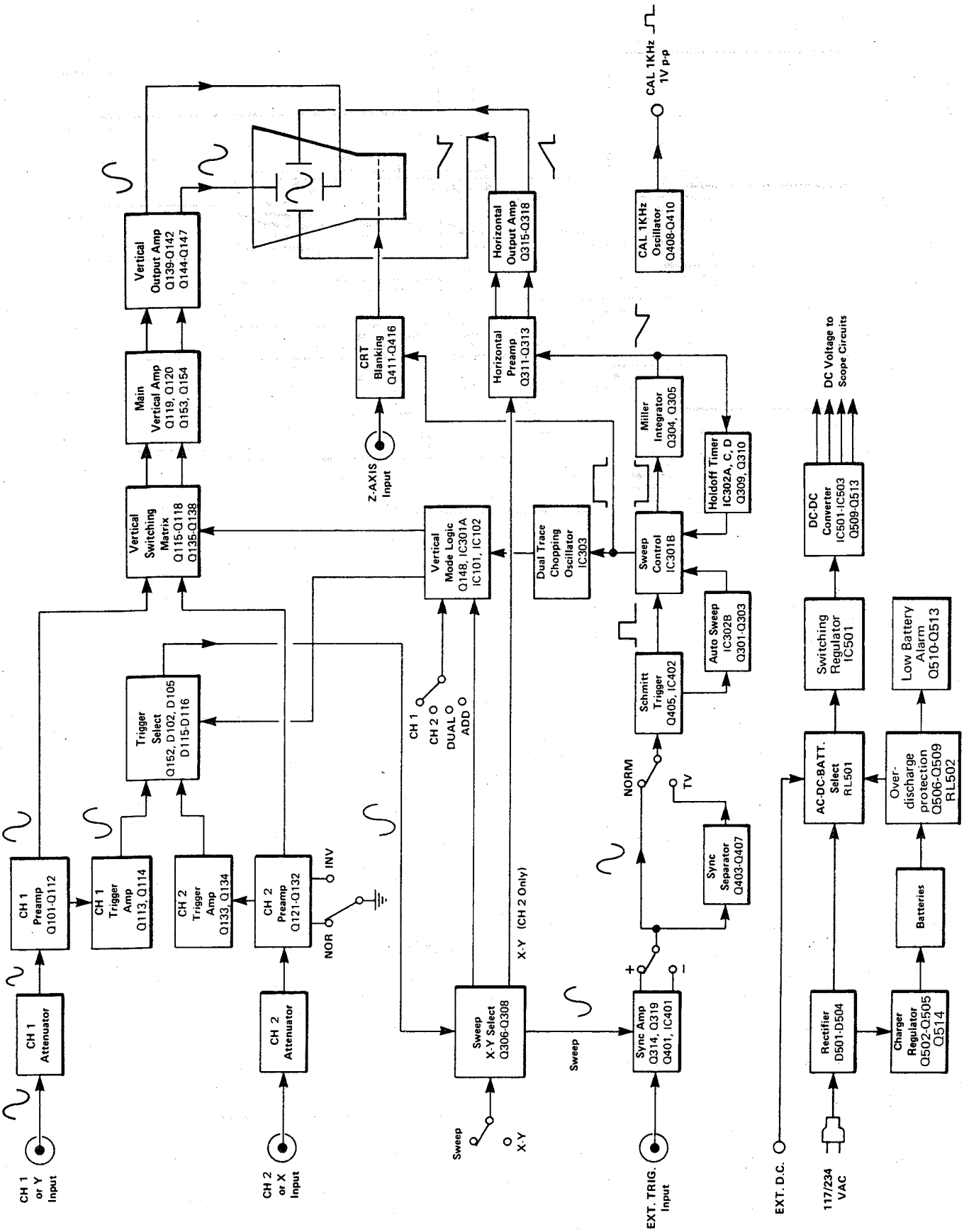


Fig. 1

CIRCUIT DESCRIPTION

The block diagram, Fig. 1, outlines the circuit breakdown of the oscilloscope. Circuit details are obtained by reference to the schematic diagram.

GENERAL

The vertical section includes identical networks for channel 1 and channel 2, each containing an input attenuator network and preamplifier. The outputs of the preamplifiers can be gated to the main vertical amplifier by the vertical switching matrix. The main vertical amplifier feeds the vertical output amplifier which drives the vertical deflection plates of the CRT. The vertical switching matrix, through the MODE switch and vertical mode logic, gates only the channel 1 signal in CH1 mode and X-Y operation, only the channel 2 signal in CH2 mode, alternately gates each in DUAL mode, or simultaneously gates both in ADD mode.
Horizontal deflection is provided by the horizontal preamplifier and horizontal output amplifier. In all except X-Y operation, input to the horizontal preamplifier is furnished by calibrated sweep speed circuits consisting of the sweep control circuit, Miller integrator, and hold-off timer. The sweep can be synchronized to the channel 1 or 2 input signal or an external trigger. The vertical mode logic controls the internal sync trigger selection; signal from the channel 1 trigger amplifier is gated through the trigger select circuit, sync amplifier, and Schmitt trigger in CH1, DUAL and ADD modes; signal from the channel 2 trigger amplifier in CH2 mode. The auto sweep circuit can start the sweep in the absence of a synchronizing trigger. When X-Y operation is selected, the channel 2 signal is coupled to the horizontal preamplifier for horizontal deflection and the sweep circuits are disabled.
The power supply allows the oscilloscope to operate from AC, external DC, or internal batteries. In each case, a DC voltage of approximately 12 volts is supplied to a DC-to-DC converter which generates all the regulated voltages used in the instrument. The charger regulator circuit keeps the batteries charged when AC power is applied. During battery operation, the low battery voltage protection shuts down operation if battery voltage becomes too low.

VERTICAL DEFLECTION CIRCUITS

Channel 1 and channel 2 networks contain identical circuitry and circuit operation is the same for both.
The channel 1 and channel 2 attenuators each have two sections. The first section provides attenuation ratios of 1:1, 10:1, 100:1 and 1000:1. The second section provides ratios of 1:1, 2:1 and 5:1. The combined effect of two sections is to provide overall attenuator ratios in a 1-2-5 sequence.
The channel 1 preamplifier consists of input FET's Q101a and Q101b, which give the scope high input impedance, and transistors Q102 thru Q112. Input source follower Q101a, in conjunction with Q101b, forms a balanced circuit to reduce thermal drift and the effects of power supply fluctuation. FET Q102 protects the preamplifier from overvoltage conditions.
The output of Q101 is applied to emitter follower transistors Q103 and Q104 which lower the output impedance to drive the second attenuator stage Q105 and Q106. Rotation of the attenuator switch changes the gain of Q105 and Q106 to provide repeating 1:1, 1:2 and 1:5 ratios. Step balance adjustment VR101 and DC balance adjustment VR102 provide variable DC offset to balance the gain of both sides of the push-pull amplifier configuration.
The output of the second attenuator is applied to transistors Q107 thru Q112 which develop sufficient gain to drive the output amplifier. Gain adjustment VR105 in the emitters of Q111 and Q112 calibrates the vertical volts/division sensitivity.
The preamplifier is cascade-connected to vertrical switching matrix Q115 thru Q118. Base drive to the proper transistor pair selects either the channel 1 or channel 2 signal to be gated to the main vertical amplifier. Polarity inversion of the channel 2 signal is also accomplished in this stage (Q135 thru Q138).
The main vertical amplifier consists of Q153-Q154 and Q119-Q120. The vertical output amplifier consists of Q139 thru Q142 and Q144 thru Q146. The output of cascade amplifieres Q139 thru Q144 is connected to the complementary circuit of Q144 through Q147. Here it is converted to a low impedance and applied directly to the vertical deflection plates of the CRT.

VERTICAL MODE LOGIC AND TRIGGER SELECTION

The first portion of the vertical mode logic consists of Q148, IC101 and IC102. This portion controls the trigger select circuit to determine whether the channel 1 or channel 2 signal will be gated to the sweep circuits for sync. The input to Q148 becomes "H" level in sweep operation and "L" level in X-Y operation. Since Q148 is an inverter, its outputs become "L" and "H" respectively. The MODE switch routes the output of Q148 to various elements of the diode OR and NAND logic, coding the MODE switch positions into $\overline{S}$ and $\overline{R}$ outputs, which are used to drive the second portion of the vertical mode logic, and to complementary control signals at IC102 pins 6 and 8. An "H" level at pin 6 selects channel 1 triggering, and an "H" level at pin 8 selects channel 2 triggering (gates the channel 2 signal to the horizontal amplifier in X-Y operation). An "L"

CIRCUIT DESCRIPTION

level at pin 6, through D102, disables Q113 and prevents the channel 1 signal from being coupled to Q152. Likewise, an "L" level at pin 8, through D105, disables Q133 and prevents the channel 2 signal from being coupled to Q152. Table 1 summarizes the logic states at primary circuit points in each mode.

Sweep Operation					
Mode	X-Y	$\overline{S}$	$\overline{R}$	IC102 Pin 8	IC102 Pin 6
CH1	H	H	L	L	H
CH2	H	L	H	H	L
DUAL	H	H	H	L	H
ADD	H	L	L	L	H

X-Y Operation					
Mode	X-Y	$\overline{S}$	$\overline{R}$	IC102 Pin 8	IC102 Pin 6
CH1	L	H	L	H	L
CH2	L	H	L	H	L
DUAL	L	H	L	H	L
ADD	L	H	L	H	L

Table 1. Summary of logic states in IC101 and IC102.

The second portion of the vertical mode logic consists of IC301A. The outputs of IC301A, Q and $\overline{Q}$, are applied to the vertical switching matrix to control gating of channel 1 and channel 2 signals to the vertical amplifier. When $\overline{Q}$ is "H" level, base drive is applied to Q115 and Q117 to gate channel 1 signals. When Q is "H" level, base drive is applied to Q135 and Q137 (normal) or Q136 and Q138 (inverted) to gate channel 2 signals. The input to IC301A are $\overline{S}$ and $\overline{R}$ logic from the first portion of the vertical mode logic circuit, and the dual trace chopping oscillator signal from IC303A. Table 2 summarizes the logic states in each mode.

		$\overline{S}$	$\overline{R}$	Q	$\overline{Q}$
Sweep Operation	CH1	H	L	L	H
	CH2	L	H	H	L
	DUAL	H	H	TOGGLE	
	ADD	L	L	H	H
X-Y Operation		H	L	L	H

Table 2. Summary of logic states in IC301A.

Except in the DUAL mode, IC301A is latched into the conditoins listed in Table 2 by the $\overline{S}$ and $\overline{R}$ inputs to allow single trace viewing of the channel 1 or channel 2 signal, or the algebraic sum of the two signals when both are selected simulaneously in the ADD mode.
In the DUAL mode, both the $\overline{S}$ and $\overline{R}$ inputs are "H" level, and the output of IC301A is determined by the input from IC303A. At sweep times of 1 millisecond to 0.5 second per division, this is a 200 kHz square wave generated by dual trace chopping oscillator IC303B and IC303C. This chops the viewable trace into 5-microsecond segments which are alternately switched between channel 1 and channel 2 to provide dual trace. At faster sweep speeds, IC303B and IC303C are switched to operate as a bistable multivibrator which changes states in synchronization with the sweep pulse from IC301B. Thus, channel 1 is viewed during one sweep, and channel 2 is viewed during the next.

TRIGGER CIRCUITS

The output of the trigger-select circuit at Q152 is routed to the sync amplifier in sweep operation, or to the horizontal preamplifier in X-Y operation, as controlled by the sweep X-Y select circuit consisting of Q306, Q307 and Q308.
In X-Y operation (SWEEP TIME/DIV switch in CH2 position), Q306 and Q307 are off, while Q308 is on. The output of Q308 provides the "L" level on the X-Y input to the vertical mode logic circuit which gates only channel 2 signal through Q152, regardless of the MODE switch position. The $\overline{S}$ and $\overline{R}$ levels also become fixed so that only channel 1 is gated to the vertical amplifier. Sweep generation is inhibited by the output from Q308 to IC301B. The output from Q306 enables Q313, which becomes the horizontal preamplifier of the channel 2 signal.
In sweep operation, the states of Q306, Q307 and Q308 are reversed compared to X-Y operation. The channel 2 signal is blocked from the horizontal amplifier because Q313 is disabled. The selected trigger from Q152 is routed through sync amplifier Q314 and Q319.
The internal trigger from Q319 or an external trigger is selected by SOURCE switch S401 and routed through Q401 to one side of differential amplifier IC401. The other input to IC401 is a DC offset voltage which is adjustable by TRIG LEVEL control VR401. Trigger adjust VR402 varies the center of the adjustment range of VR401. SLOPE switch S402 selects either polarity output from IC401.
The SYNC switch routes the sync signal output of IC401 directly through emitter follower Q405 to Schmitt trigger IC402 in the NOR (normal) position. In the VIDEO position, the sync signal is first routed through the sync separator circuits consisting of Q403, Q404, Q406 and Q407. Composite video signals are detected and biased by Q403 and Q404 so that only the tips of the sync pulses pass. At sweep speeds of 0.1 millisecond per division and slower, capacitor C411 is switched in by Q406 and Q407 to filter out the horizontal sync pulses.

SWEEP AND HORIZONTAL CIRCUITS

The basic sweep circuits consists of sweep control flip-flop IC301B, Miller integrator Q304 and Q305, and hold-off timer Q309, Q310 and IC302. Schmitt trigger output from IC402 clocks sweep control flip-flop IC301B. On the

negative edge of the clock waveform, the Q output goes low and the sweep begins. The selected timing capacitor and resistors, along with Q304 and Q305, form a Miller integrating circuit that produces a linear ramp waveform.
When the ramp voltage reaches a predetermined amplitude, hold-off timer Q310, Q309 and IC302A, C, & D sends a pulse to stop the sweep and invert the IC301B output. It is held in this condition until the next clock pulse occurs.
The auto sweep circuit, composed of IC302B and Q301 thru Q303 checks the presence of output pulses from the Schmitt trigger. If no pulses are detected and PULL AUTO triggering switch is on, IC301B will free run.
The sweep waveform is applied to horizontal preamplifier Q312, further amplified by horizontal output amplifiers Q315 thru Q318 and applied to the horizontal deflection plates of the CRT.
The Q sweep pulse from IC301B to IC303B keeps the dual trace chopping oscillator in sync with the sweep. The Q sweep pulse to inverter IC303D drives the blanking circuits.

BLANKING AND INTENSITY CIRCUITS

This circuit consists of transistors Q411 thru Q416. The unblanking signal from IC303D is fed through INTENSITY control VR3 to amplifier Q414, Q413 and Q412. This curcuit is a cascade amplifier in which Q412 is a constant current load in the feedback from Q412 to Q414.
Transistor Q411 and diode D405 are switched by the pulse signals from the DC-to-DC converter. The switched output of Q411 amplitude modulates the output of Q412 through diode D404. Intensity adjustment VR405 is connected to the unblanking circuit through diode D406, and adjusts the point in the INTENSITY control at which the trace is extinguished.
An amplitude-modulated unblanking signal goes through C423 to D407 and D408, and is converted to DC. This voltage is delivered with the unblanking signal coupled by C422 to the grid of the CRT.
Z-axis input is amplified by Q415 and superimposed on the unblanking signal. The astigmatism voltage is adjusted by VR1, buffered by Q416 and delivered to the CRT.
A portion of the high voltage is fed back to error amplifier IC503, which regulates the voltage through Q513.

CALIBRATION VOLTAGE CIRCUIT

Transistors Q409 and Q410 form an astable multivibrator at 1 kHz. Adjustments VR404 and VR406 vary the frequency and duty cycle respectively. The square wave is amplified by Q408 and adjusted to a peak-to-peak amplitude of 1 volt by VR403.

POWER SUPPLY

AC Rectifier

AC voltage from the power transformer is converted to DC by rectifier diodes D501 thru D504 and filter capacitors C501 and C525. Rectifier output is continually applied to the charger regulator when AC power is applied, even when POWER switch S1 is off. The rectifier output is also applied through contacts of relay RL501 to the DC-to-DC converter.

Charger Regulator

The charger regulator consists of Q501 thru Q505. This circuit is fed by the AC rectifier through resistors R502 and R528. The voltage at the cathode of D506 is adjusted to +13.7 volts by VR501 and supplies charging current to the battery. The charging current develops a voltage across R502 and R528 that drives Q514 and illuminates the CHARGE LED.

AC-DC-Battery Select

External DC has priority over other power sources, and prevents damage if AC and DC power are accidentally applied simultaneously. A mechanically operated switch opens the AC and battery path whenever a connector is plugged into the EXT DC jack. When AC power is applied, relay RL501 operates. Its contacts disconnect the battery from the DC-to-DC converter and connect the output of the AC rectifier. In the absence of external DC or AC power, the battery output is routed through the contacts of unoperated RL501 and operated RL502 to the DC-to-DC converter.

Low Battery Voltage Protection

This circuit includes Q505 thru Q508 and relay RL502. Relay RL502 is operated whenever the POWER switch is on, unless the battery voltage drops below 10.5 volts. A regulated reference voltage is generated by Q505 and Zener diode D507. The voltage from VR502, which is proportional to battery voltage, is compared to the reference voltage by Q507 and Q508. When battery voltage is above the reference, Q506 operates RL502; below the reference Q506 and RL502 turn off.

Low Battery Flasher

At normal battery voltage, Q520 thru Q523 are on, lighting the POWER LED continuously. VR505 is adjusted so that Q521 and Q522 begin operation as an astable multivibrator when battery voltage drops to 11 volts. This interrupts drive to Q523, flashing the POWER LED on and off.

DC-to-DC Converter

Switching regulator IC501 is self-oscillating and drives Q509 and Q510. This portion of the circuit develops a regulated DC drive voltage over a wide range of input voltage. Feedback to stabilize the output is from the secondary of the DC-to-DC converter through D523. Adjustment VR503 sets low voltage level. Diode D523 also protects against abnormal oscillation of the DC-to-DC converter due to delayed control of the switching regulator at the instant power is turned on.
Power transistors Q511 and Q512 adopts a Royer circuit which is stable and self-oscillating. The oscillations are transformer-coupled and rectified to provide all the DC operating potentials for the instrument. The 1500 volts high voltage is generated by voltage double D516 and D517, and regulated by IC503 and Q513.

MAINTENANCE AND ADJUSTMENT

MAINTENANCE

WARNING

High voltages up to 1500 VDC are present when this instrument is operating. Take precautions to avoid electrical shock when the housing is removed.

DISASSEMBLY PROCEDURE

For troubleshooting and repair of the Model CS-1352 Oscilloscope, it is necessary to partially disassembly the unit for access to some circuits. Fig. 2 identifies the circuit board assemblies and illustrates the accessibility method for servicing the oscilloscope. Removal of some items is not obvious; use the following procedures to simplify the task.

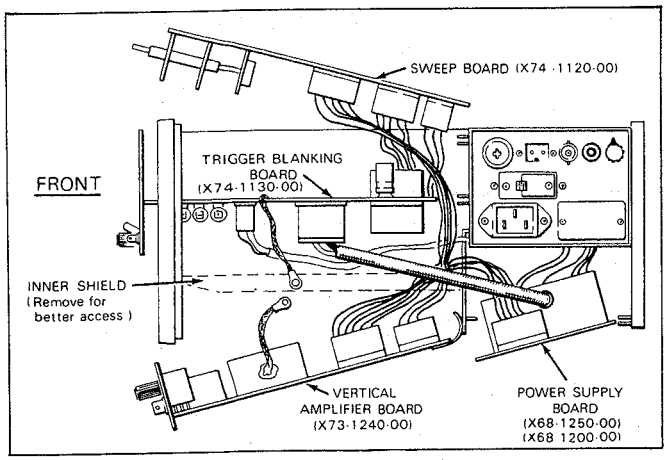


Fig. 2 Accessibility for trouble shooting and testing

Removal of Oscilloscope From Housing (Fig. 3)

1. If oscilloscope is equipped with optional battery pack, remove rear panel and batteries. Otherwise, leave rear panel attached to housing.
2. Remove two Phillips-head screws from top of housing and two from bottom.
3. Slide complete oscilloscope chassis out through the front of the housing.

Removing Shield From Bottom of Chassis (Fig. 4)

1. Lay oscilloscope chassis on its back.
2. Loosen, but do not remove, Phillips-head screw at front edge of shield (through edge of front bezel).
3. Remove Phillips-head screws from bottom of shield.
4. To remove shield, spring outward in center and slide forward to clear tabs at rear of chassis, then lift off shield while sliding rearward.

Removing Vertical Amplifier Board (Fig. 2)

1. Remove shield from bottom of chassis.
2. Remove Phillips-head screw at front edge of the circuit board (this is the same screw that was loosened in step 2 of "Removing Shield From Bottom of Chassis" procedure).
3. Remove two Phillips-head screws which secure front panel to front bezel.
4. Release tabs at bottom edge of lower front panel from notches in front bezel, and slide board forward through opening in front bezel far enough to clear chassis tabs at rear edge of board.
5. Gently swing board away from chassis and disconnect plugs P1 and P2 and two white wires from CRT to pins 3 and 4 of vertical amplifier board. Refer to Fig. 5 when reconnecting CRT wires to board.
6. Remove entire board assembly through opening in front bezel.
7. Power can be reapplied for testing and troubleshooting while board is removed from chassis by simply reconnecting P1 and P2 and the two CRT wires. For more freedom of movement, loosen or remove the cable clamp which secures the cables near the rear of the inner shield.
8. When replacing this board, be sure board is sandwiched between the center tab and two outer tabs on the chassis at the rear edge of the board as shown in Fig. 6.

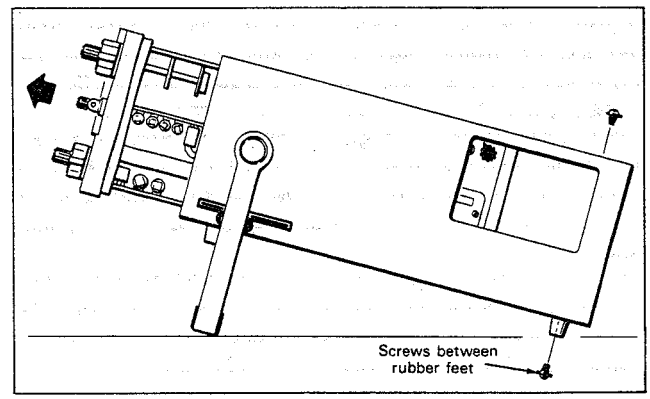


Fig. 3 Removal of unit from housing

Removing Sweep Board (Fig. 2)

1. Remove SWEEP TIME/DIV knobs. Small knob requires 2 mm Allen wrench. Large knob has two set screws.
2. Remove knobs from ◄► POSITION, FOCUS, AND POWER/INTEN controls.
3. Remove slotted lock nut from shaft of POWER/INTEN control, and 7/16" hex lock nut and washer from shaft of SWEEP TIME/DIV control.
4. Remove clamp bracket and mounting screw at rear edge of sweep board.
5. Gently lift rear edge of sweep board and disconnect plugs P301 thru P304, the two white wires from the CRT to pins 1 and 2 of the board, and the black ground wire.
6. Gently pull board rearward so control shafts are pulled through upper front panel.
7. Remove POWER/INTEN and FOCUS controls from the inner front panel portion of the sweep board assembly.
8. Power can be reapplied for testing and troubleshooting while sweep board is removed from chassis by reconnecting P301 thru P304 and the two white CRT wires.

Refer to Fig. 5 for correct connections. The black wire ground connection is not needed in most cases. Use a clip lead if the added shielding effect is desirable.

9. To completely remove sweep board from chassis, pry loose LED rataining collars on inside of inner front panel, push LED's and sleeve through front panel, and remove sleeves from LED's.

Removing Trigger Blanking Board (Fig. 2)

1. Remove bottom shield and vertical amplifier board.
2. Remove Phillips-head screw and cable clamp that secures the inner shield. Remove the inner shield.
3. Access is now provided to all parts on the trigger blanking board for testing and troubleshooting.
4. If board must be removed from chassis, as in parts replacement:
   a. Remove sweep board.
   b. Unplug P401 thru P409 from bottom of board and P407 from top of board, and black ground wire (pin 1 of trigger blanking board).
   c. Unsolder red wire from power supply and blue wire from CRT at edge of trigger blanking board near P407.
   d. Remove two Phillips-head screws that secure upper front panel to front bezel.
   e. Release tabs on upper front panel from notches in front bezel adjacent to the CRT screen.
   f. Remove entire board assembly through opening in front bezel. Temporarily unplug the wire from pin 2 of the trigger blanking board to the CAL 1 kHz terminal on the front panel to allow easier passage through front bezel opening.
5. When replacing board, make sure rear edge of board is sandwiched between the center tab and two outer tabs of the chasis, per Fig. 6.

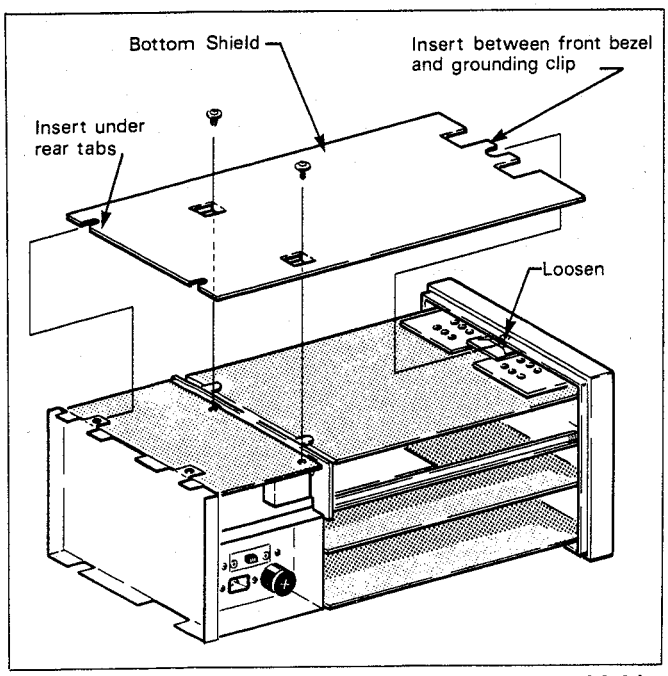


Fig. 4 Removal and replacement of bottom shield

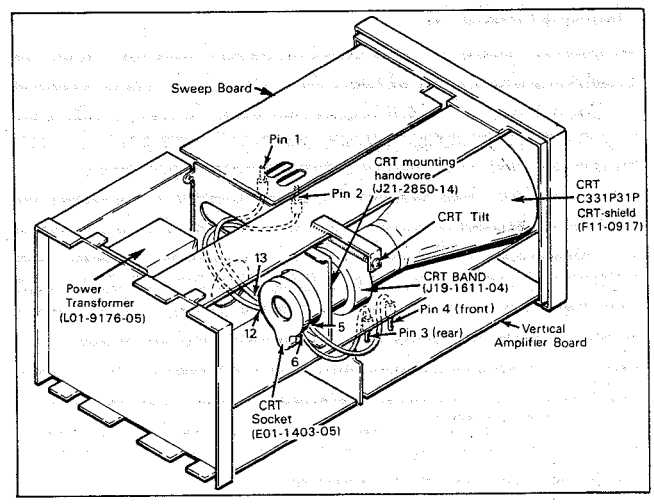


Fig. 5 X and Y deflection plate wiring scheme

Removing Power Supply Board

1. Remove bottom shield.
2. Unbend or remove cable clamp near rear of inner shield.
3. Leave all connectors fastened to power supply board. Lift front edge of board and slide forward to clear tabs at rear of chassis. Extend board as far as cables will allow for testing and troubleshooting with power applied.
4. When replacing board, make sure rear edge of power supply board is sandwiched between the center tab and outer rounded tabs (not the square tabs) on the chassis per Fig. 6.
5. For complete access to components on board with power removed, disconnect plugs P501 thru P506 and black ground wire (pin 4 of power supply board), and fold board to side.
6. To completely remove power supply board from chassis, remove vertical amplifier board and inner shield for access to P406, then disconnect P406 from the trigger blanking board and unsolder the red wire adjacent to P407 on the trigger blanking board.

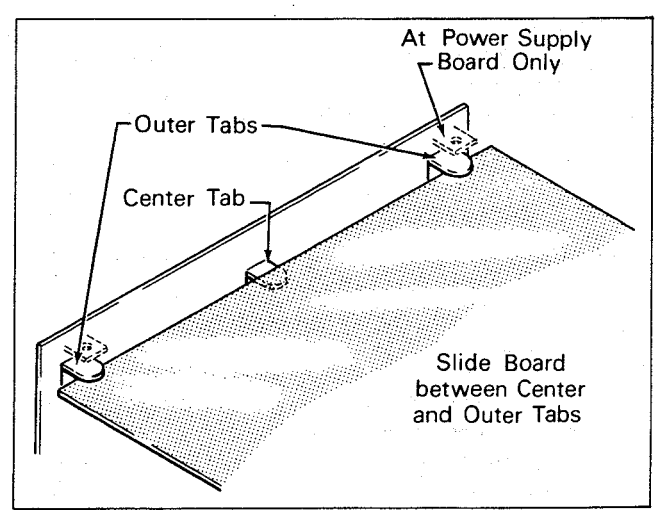


Fig. 6 Typical support arrangement at rear edge of circuit board

ADJUSTMENTS

A general check of calibration accuracy may be made by displaying the output of the CAL 1 kHz ⎍ 1 Vp-p terminal on the screen. This test signal has been factory-calibrated to provide an accurate square wave of 1 volt peak-to-peak amplitude and 1 millisecond time duration per cycle.
At 0.2 V/DIV, this should produce exactly 5 divisions of vertical deflection on channel 1 or channel 2 or 5 divisions of horizontal deflection in X-Y operation when the VARIABLE controls are set to CAL. The 20 mV/DIV range may be used to check the 10:1 attenuation of the probe; again, exactly 5 divisions of deflection should result.
With a .1 mS/DIV sweep time and VARIABLE set to CAL, one cycle of the waveform should occupy exactly 10 divisions. At 1 mS/DIV sweep time, 10 cycles should exactly span the 10 divisions, while 2 cycles should cover the 10 divisions using X5 magnification.
The calibration adjustments outlined here are those which can be performed with a minimum of specialized test equipment. Additional internal adjustments of frequency compensation and horizontal sweep linearity should not be attempted without complete service information and specified test equipment.
Internal adjustments outlined in the calibration procedure can be located by reference to Fig. 7 through 10.

Power Supply Adjustments

Low Voltage

1. Connect DC voltmeter to measure voltage at pin 4 of P503 with respect to chassis ground.
2. Adjust VR503 (low voltage) for 10 volts on voltmeter.

High Voltage

1. Connect DC voltmeter with high voltage probe (combination of meter and probe should have input impedance of 100 megohms or more) to measure voltage at pin 1, 3 or 14 of CRT socket with respect to chassis ground.
2. Adjust VR504 (hi voltage) for 1.5 kV on voltmeter.

Charge Voltage

1. Disconnect and remove batteries from oscilloscope.
2. Connect DC voltmeter to measure voltage between red and black battery leads.
3. Adjust VR501 (charge voltage adjust) for 13.7 volts on voltmeter.

Battery Low Voltage

1. Remove AC power from oscilloscope.
2. Connect a variable DC power supply in place of the batteries and set to approximately 12 volts.
3. Connect DC voltmeter to measure output voltage of power supply.
4. Slowly reduced power supply output voltage and note voltage at which POWER indicator starts to flash, and at which oscilloscope shuts down.
5. Adjust VR505 and VR502 and repeat step 4 until flashing starts at 11 V and shutdown occurs at 10 V.

Astigmatism

1. Set SWEEP TIME/DIV switch to CH2 position and channel 1 and channel 2 AC-GND-DC switches to GND position. This will produce a spot on the screen.
2. With POWER/INTEN control set about mid-range, adjust both the ASTIG and FOCUS controls for the sharpest, roundest spot. Do not readjust ASTIG control after this step.

CAUTION

Never allow a small spot of high brilliance to remain stationary on the screen for more than a few seconds. The screen may be permanently burned.

Intensity

1. Set SWEEP TIME/DIV switch to CH2 position and channel 1 and channel 2 AC-GND-DC switches to GND position. This will produce a spot on the screen.
2. Turn POWER/INTEN control clockwise until brightness increases, then counter-clockwise until brightness decreases to the point where it just disappears.
3. Adjust VR405 (inten adj) and repeat step 2 until spot just disappears when POWER/INTEN control knob reaches 10 o'clock position.
4. Set POWER/INTEN control to approximately 3 o'clock position for remaining adjustments.

DC Balance

1. Set scope controls for a single horizontal trace on channel 1 with the channel 1 AC-GND-DC switch set to GND position.
2. Rotate the channel 1 VARIABLE control from maximum clockwise to maximum counter-clockwise, while observing the trace.
3. If the trace moves vertically, adjust VR102 (vari) for minimum or zero movement when performing step 2.
4. Rotate channel 1 VOLTS/DIV switch through the 2 mV, 5 mV and 10 mV positions while observing the trace.
5. If the trace moves vertically, adjust VR101 (step bal) for minimum or zero vertical movement when performing step 4.
6. Repeat the entire procedure for channel 2, adjusting VR107 for VARIABLE balance and VR106 for VOLTS/DIV step balance.

Vertical Gain

1. Set channel 1 and channel 2 VOLTS/DIV controls to 10 mV position and VARIABLE controls to CAL.
2. Apply a calibrated 1 kHz, 50 mV peak-to-peak square wave signal to channel 1 input and set MODE switch to CH1. Set oscilloscope controls to display square wave on CRT screen.
3. Adjust VR105 (gain) for exactly 5 divisions amplitude on CRT screen.
4. Repeat steps 2 and 3 for channel 2, adjusting VR110 (gain).
   If calibration generator is not available as a source of calibrated 50 mV peak-to-peak square wave signal, the following method is acceptable:
   a. Using a sine/square wave generator, apply sine wave signal of approximately 1 kHz to oscilloscope input.
   b. Measure level of sine wave signal with AC voltmeter. Meter must be accurate (1%) at 1 kHz.
   c. Adjust generator level for 17.7 mV RMS on AC voltmeter. (17.7 mV RMS = 50 mV p-p)
   d. Adjust VR105 for channel 1 or VR110 for channel 2 for 5 divisions amplitude on CRT screen.

Attenuation

1. Perform "Vertical Gain" calibration adjustments.
2. Set VOLTS/DIV switches to 0.1 position and increase generator output to 500 mV peak-to-peak. Adjust TC101 for channel 1 and TC107 for channel 2 for 5 divisions amplitude.
3. Set VOLTS/DIV switches to 1 position and increase generator output to 5 volts peak-to-peak. Adjust TC102 for channel 1 and TC108 for channel 2 for 5 divisions amplitude.
4. Set VOLTS/DIV switches to 10 position and increase generator output to 50 volts. Adjust TC103 for channel 1 and TC109 for channel 2 for 5 divisions amplitude.
5. For each setting of the VOLTS/DIV attenuators from 10 mV to 10 V, apply a square wave of calibrated peak-to-peak voltage that is 5 times the attenuator setting (for 0.2 V position apply 1-volt p-p square wave). Vertical deflection should be 5 divisions (±0.25 division) for each setting.
6. Amplitude should reduce from 5 divisions to less than 2 divisions when VARIABLE controls are turned from maximum to minimum.
   If calibration generator is not available as a source of square wave signal with calibrated peak-to-peak voltage levels, use method prescribed for "Vertical Gain" calibration adjustments with the following levels: 177 mV RMS = 500 mV p-p, 1.77 V RMS = 5 V p-p, 17.7 V RMS = 50 V p-p.

X-Y Position and Gain

1. Set channel 2 POSITION control to mechanical center (12 o'clock position).
2. Set channel 2 AC-GND-DC switch to GND position.
3. Set SWEEP TIME/DIV switch to CH2 position. 1 dot should appear on CRT screen.
4. Adjust VR305 (X-Y posi) to center the dot horizontally on screen.
5. Set channel 2 VOLTS/DIV switch to 10 mV position and VARIABLE to CAL.
6. Set channel 2 AC-GND-DC switch to AC position and apply a calibrated 50 mV peak-to-peak sine wave to channel 2 input.
7. Adjust VR111 (X-Y gain) for exactly 5 divisions horizontal deflection on CRT screen.

Blanking

1. Set SWEEP TIME/DIV switch to 5 μS position and VARIABLE to CAL. Pull out on PULL X5 MAG knob and set ◄► POSITION control to view beginning of trace.
2. Apply 1 MHz, 50 mV sine wave signal and display it on CRT screen.
3. Adjust TC401 (blanking) so that starting point of waveform is just barely blanked.

Horizontal Position

1. Set ◄► POSITION control at its mechanical center (12 o'clock position).
2. Set oscilloscope controls to display a single horizontal trace.
3. Adjust VR304 (posi adj) to start the trace at the left edge of the graticule scale.

Triggering Level

1. Apply 1 kHz sine wave and set oscilloscope controls to display waveform on CRT screen at 5 divisions amplitude.
2. Adjust VR402 (trig adj) to make waveform stable with TRIG LEVEL control at 12 o'clock position.
3. Triggering should be satisfactory when amplitude is less than 1 division through a frequency range of 20 Hz to 15 MHz.

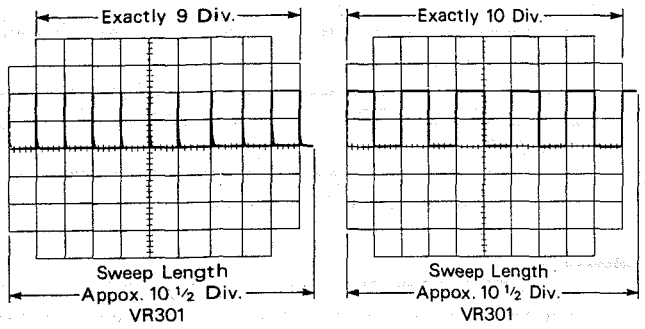
Sweep Adjustments

1. Set SWEEP TIME/DIV switch to .1 mS position and VARIABLE control to CAL.
2. Apply 0.1 millisecond markers or 5 kHz square wave and set controls to display them on screen. Measuring the time period of the markers or the frequency of the square wave on a frequency counter will assure calibration accuracy.
3. Adjust VR303 (time) so that the 10 visible markers occupy exactly 9 divisions of horizontal deflection, or that the 5 cycles of square wave occupy exactly 10 horizontal divisions as shown in Fig. 7 and Table 3.
4. Adjust VR301 (length) for a total sweep length of $10\frac{1}{2}$ divisions.

Sweep Time/Div.	Markers	Adjust
.1 mS	.1 mS	VR303
10 μS	10 μS	TC301
.5 μS	.5 μS	TC302
Sweep Linearity		TC303

Sweep Time/Div.	Square Wave	Adjust
.1 mS	5 KHz	VR303
10 μS	50 KHz	TC301
.5 μS	1 MHz	TC302
Sweep Linearity		TC303

Table 3



Using Marker Pulses **Using Square Waves**

Fig. 7 Sweep adjustments

5. Recheck steps 3 and 4 for any interaction. Repeat if required.
6. Set SWEEP TIME/DIV switch to 10 μS position.
7. Apply 10 microsecond markers or 50 kHz square wave and adjust TC301 (10 μS) to duplicate the conditions shown in Fig. 7 and Table 3.
8. Set SWEEP TIME/DIV switch to .5 μS position.
9. Apply 0.5 microsecond markers of 1 MHz square wave and adjust TC302 (0.5 μS) to duplicate the conditions shown in Fig. 7 and Table 3.
10. With oscilloscope set up as shown in Fig. 7 and Table 3, alternately pull and push the PULL X5 MAG knob. Adjust VR306 *(mag posi)* so that the center mark remains stationary whether the PULL X5 MAG switch is on or off. Do not rotate the ◄► POSITION control.
11. Adjust VR307 (mag gain) so that the markers that were one division apart in normal operation are exactly 5 divisions apart in X5 magnification operation.
12. Using X5 magnification, set SWEEP TIME/DIV switch to .5 μS position and apply 10 MHz sine wave signal. With good sweep linearity, the screen should display 10 cycles of symmetrical sine wave, with each cycle having exactly equal horizontal deflection. Adjust TC303 (linearity) if needed for good sweep linearity, then recheck steps 1 thru 11 for possible interaction. *If interaction is noted, repeat entire procedure.*

Internal Square Wave Generator Calibration

1. Connect output of CAL 1 kHz ⎍ 1 Vp-p terminal to frequency counter and adjust VR406 (freq adj) for 1 kHz indication on frequency counter.
2. Connect output of CAL 1 kHz ⎍, 1 Vp-p terminal to channel 1 input and set oscilloscope controls to display one cycle of square wave.
3. Adjust VR404 (duty adj) so that the square wave is symmetrical; that is, so that positive and negative portions of the trace are equal in length.
4. The channel 1 attenuator must be previously calibrated as prescribed in this manual to perform this step. Set channel 1 VOLTS/DIV switch to 0.2 position and VARIABLE control to CAL. Adjust VR403 (cal adj) for 5 divisions amplitude.

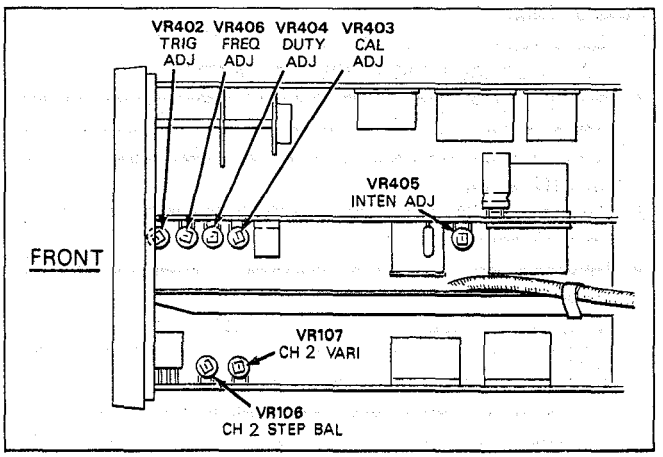


Fig. 8 Location of adjustments, right side of scope

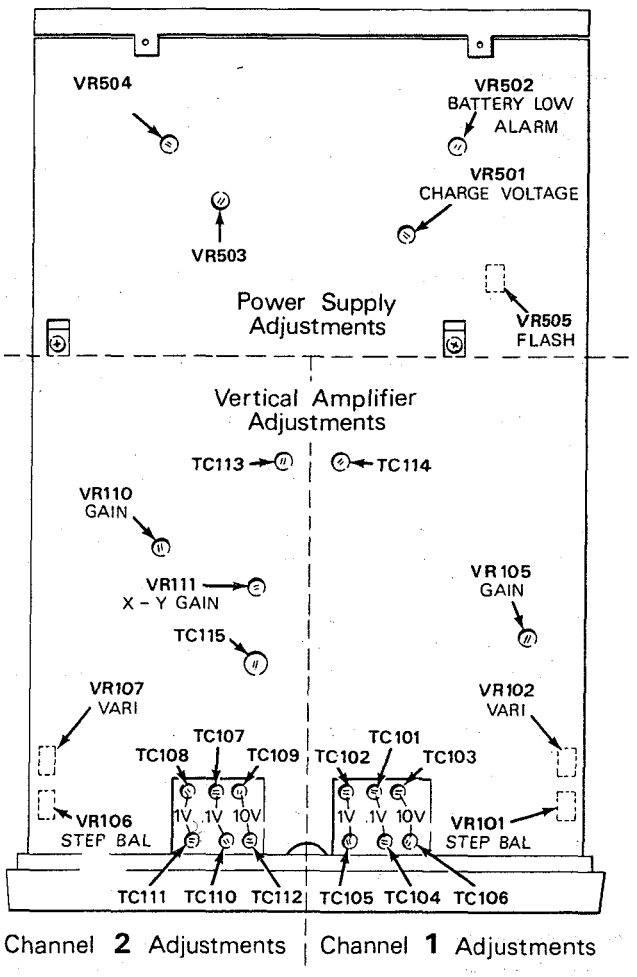


Fig. 9 Location of adjustments, bottom of scope

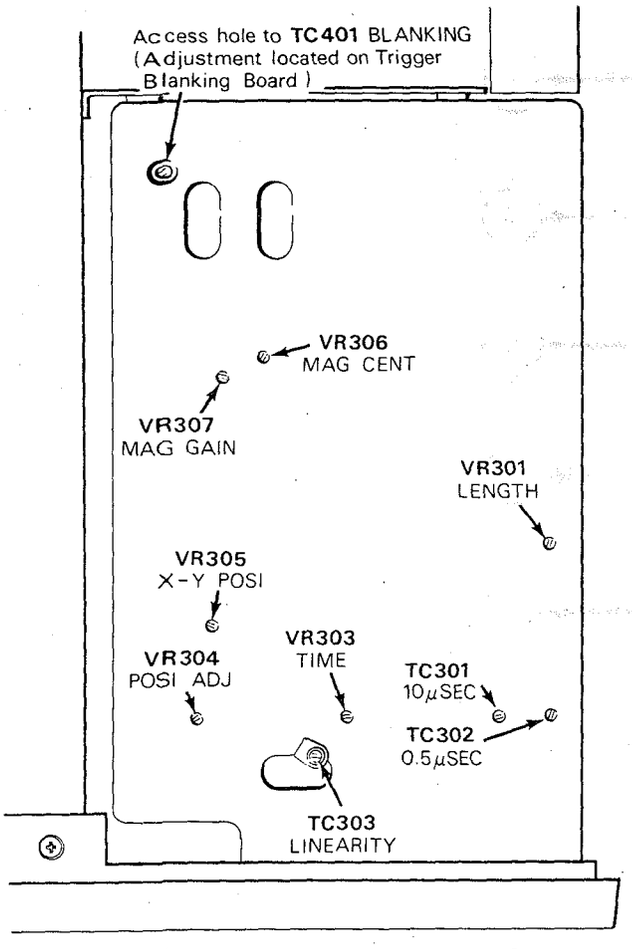


Fig. 10 Location of adjustments, top of scope

FUNCTION OF ADJUSTMENTS

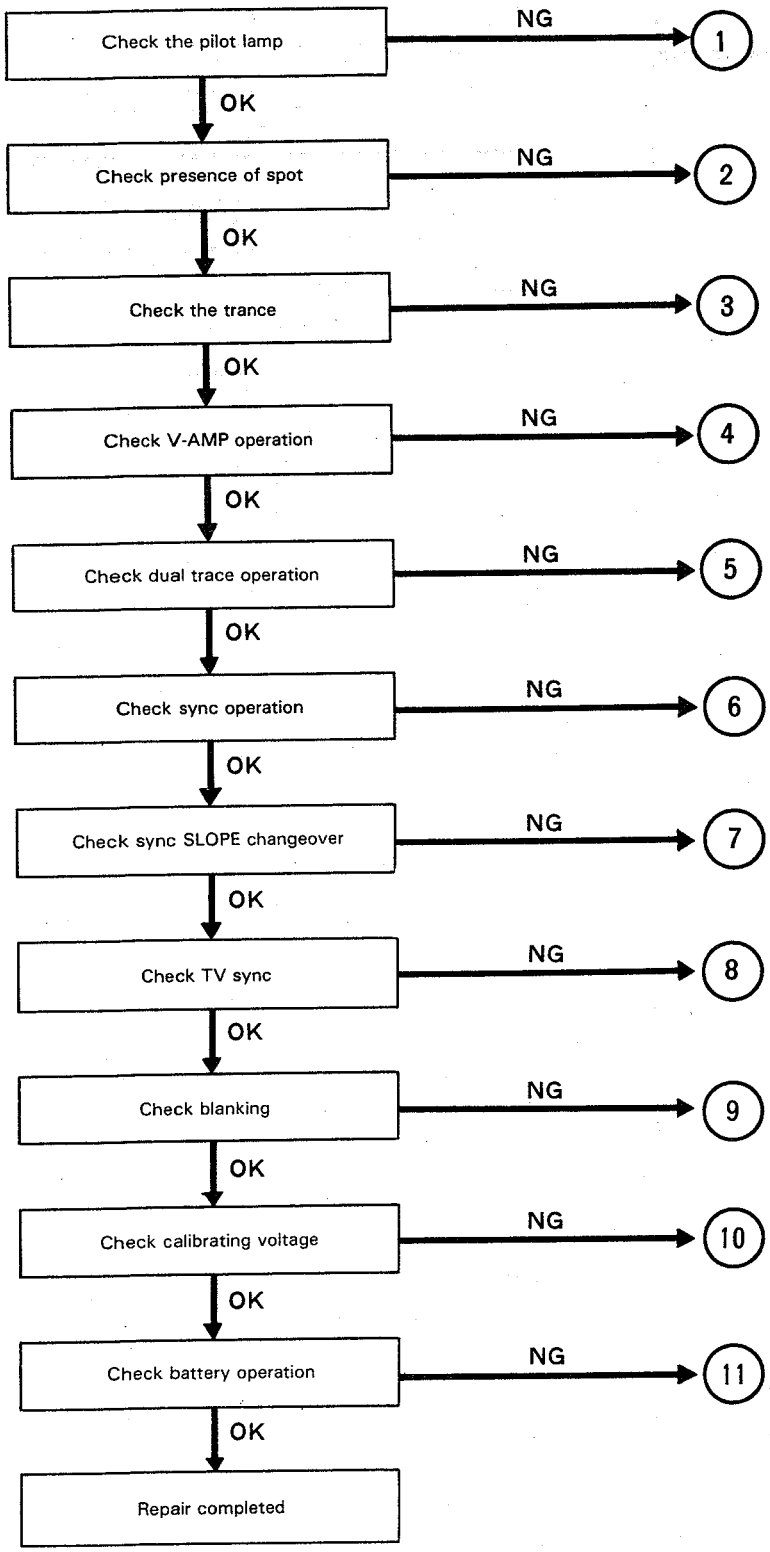
VERTICAL UNIT ADJ. (X73-1240-00)	
VR105	CH1 VERTICAL GAIN ADJ.
VR110	CH2 VERTICAL GAIN ADJ.
VR111	X GAIN ADJ.
TC101-103,107-109	VERTICAL HIGH FREQUENCY SQUARE WAVE ADJ.
TC113,114	VERTICAL HIGH FREQUENCY ADJ.
TC115	CH2 FREQUENCY ADJ.
TC104-106,110-112	VERTICAL INPUT CAPACITY ADJ.

SWEEP UNIT ADJ. (X74-1120-00)	
VR301	HORIZONTAL SWEEP LENGTH ADJ.
VR303	SWEEP TIME ADJ.
VR304	SWEEP POSITION ADJ.
VR305	X-Y POSITION ADJ.
VR306	MAG CENTER POSITION ADJ.
VR307	MAG GAIN ADJ.
TC301	10μS ADJ.
TC302	0.5μS ADJ.
TC303	SWEEP LINEARITY ADJ.

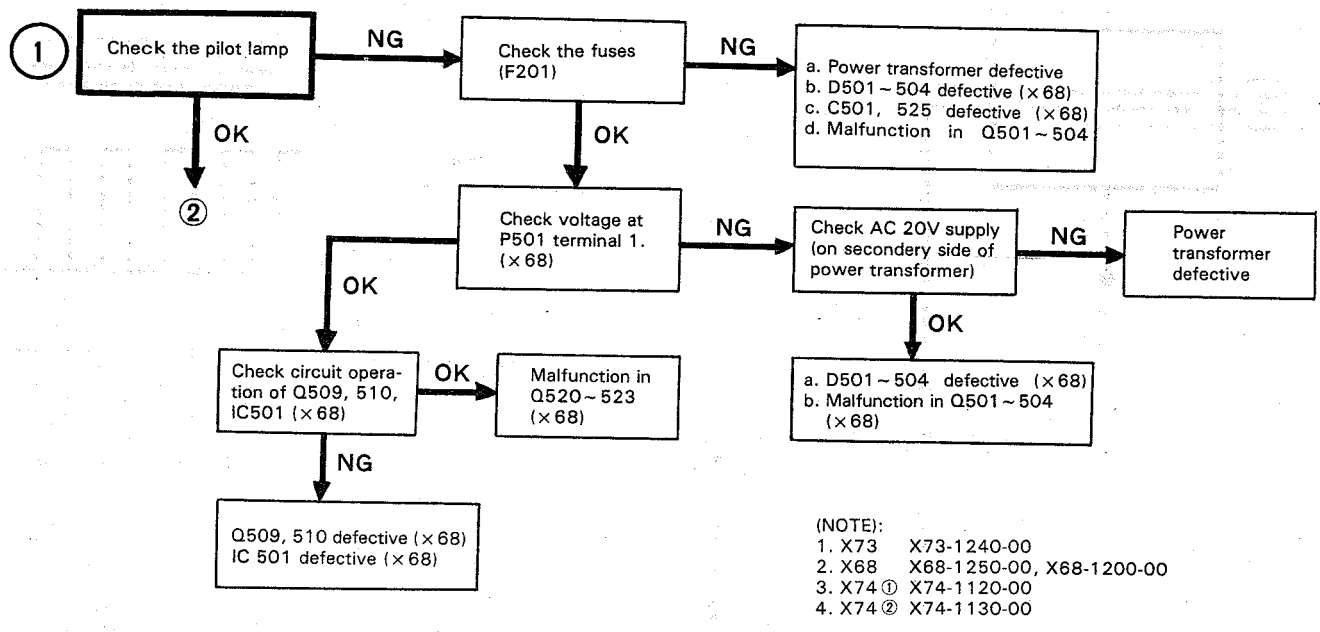
TRIGGER BLANKING UNIT ADJ. (X74-1130-00)	
VR402	SLOPE OFF-SET ANJ.
VR403	CAL VOLTAGE ADJ.
VR404	DUTY RATIO ADJ.
VR405	CRT INTENSITY ADJ.
VR406	CAL FREQUENCY ADJ.
TC401	TRIG.BLANKING ADJ.

POWER SUPPLY UNIT ADJ. (X68—1250-00) (X68-1200-00)	
VR501	CHARGE VOLTAGE ADJ.
VR502	BATTERY LOW VOLTAGE ALARM ADJ.
VR503	+10V (LOW VOLTAGE) ADJ.
VR504	+1.5kV (HIGH VOLTAGE) ADJ.
VR505	BATTEY LOW VOLTAGE FLASHING ADJ.

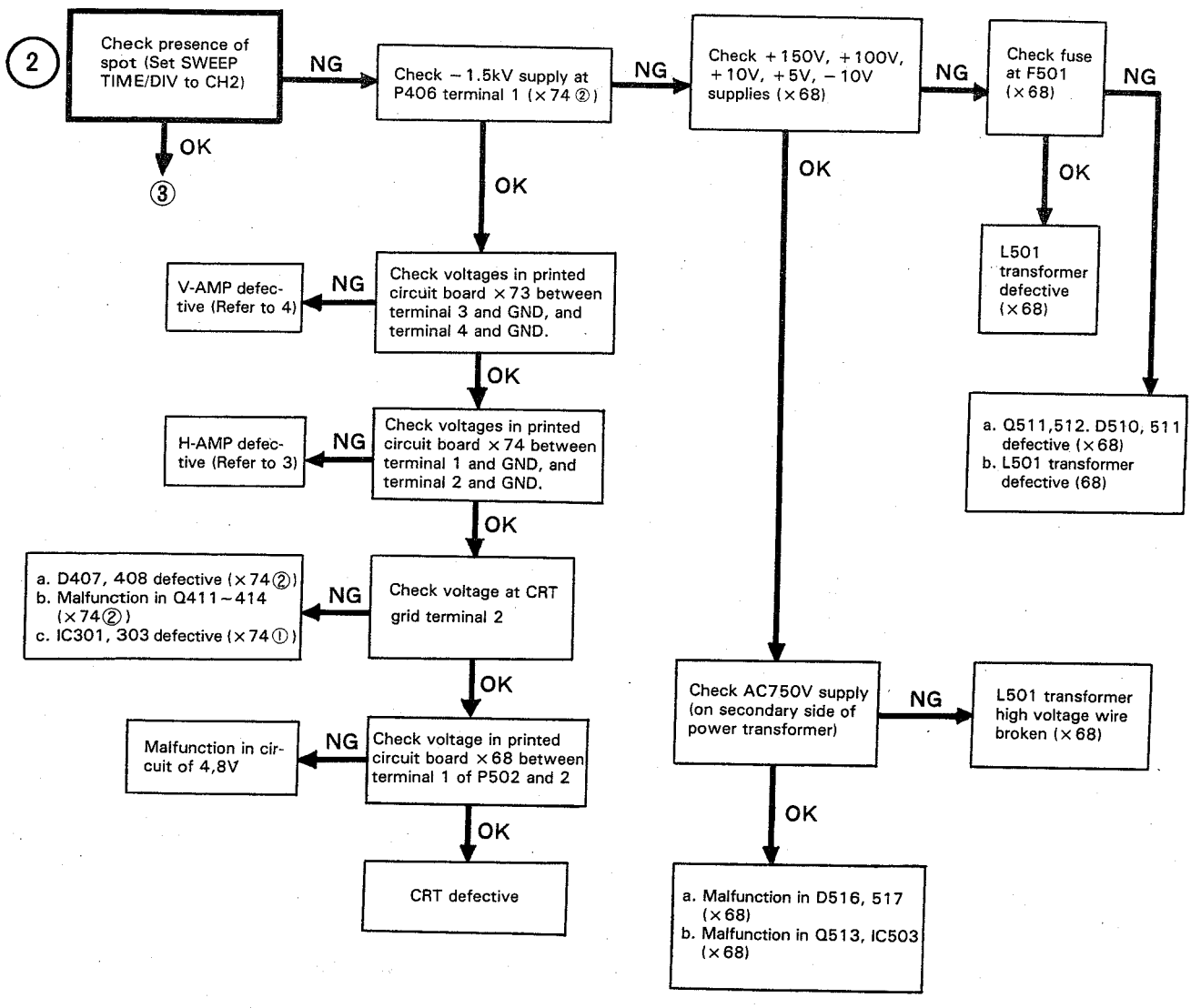
TROUBLE SHOOTING



TROUBLE SHOOTING



(NOTE):
1. X73 X73-1240-00
2. X68 X68-1250-00, X68-1200-00
3. X74① X74-1120-00
4. X74② X74-1130-00


2
Check presence of spot (Set SWEEP TIME/DIV to CH2)
NG
Check −1.5kV supply at P406 terminal 1 (×74②)
NG
Check +150V, +100V, +10V, +5V, −10V supplies (×68)
NG
Check fuse at F501 (×68)
NG
OK
③
OK
OK
OK
V-AMP defective (Refer to 4)
NG
Check voltages in printed circuit board ×73 between terminal 3 and GND, and terminal 4 and GND.
L501 transformer defective (×68)
OK
H-AMP defective (Refer to 3)
NG
Check voltages in printed circuit board ×74 between terminal 1 and GND, and terminal 2 and GND.
a. Q511,512. D510, 511 defective (×68)
b. L501 transformer defective (68)
OK
a. D407, 408 defective (×74②)
b. Malfunction in Q411~414 (×74②)
c. IC301, 303 defective (×74①)
NG
Check voltage at CRT grid terminal 2
OK
Check AC750V supply (on secondary side of power transformer)
NG
L501 transformer high voltage wire broken (×68)
OK
Malfunction in circuit of 4,8V
NG
Check voltage in printed circuit board ×68 between terminal 1 of P502 and 2
OK
a. Malfunction in D516, 517 (×68)
b. Malfunction in Q513, IC503 (×68)
CRT defective

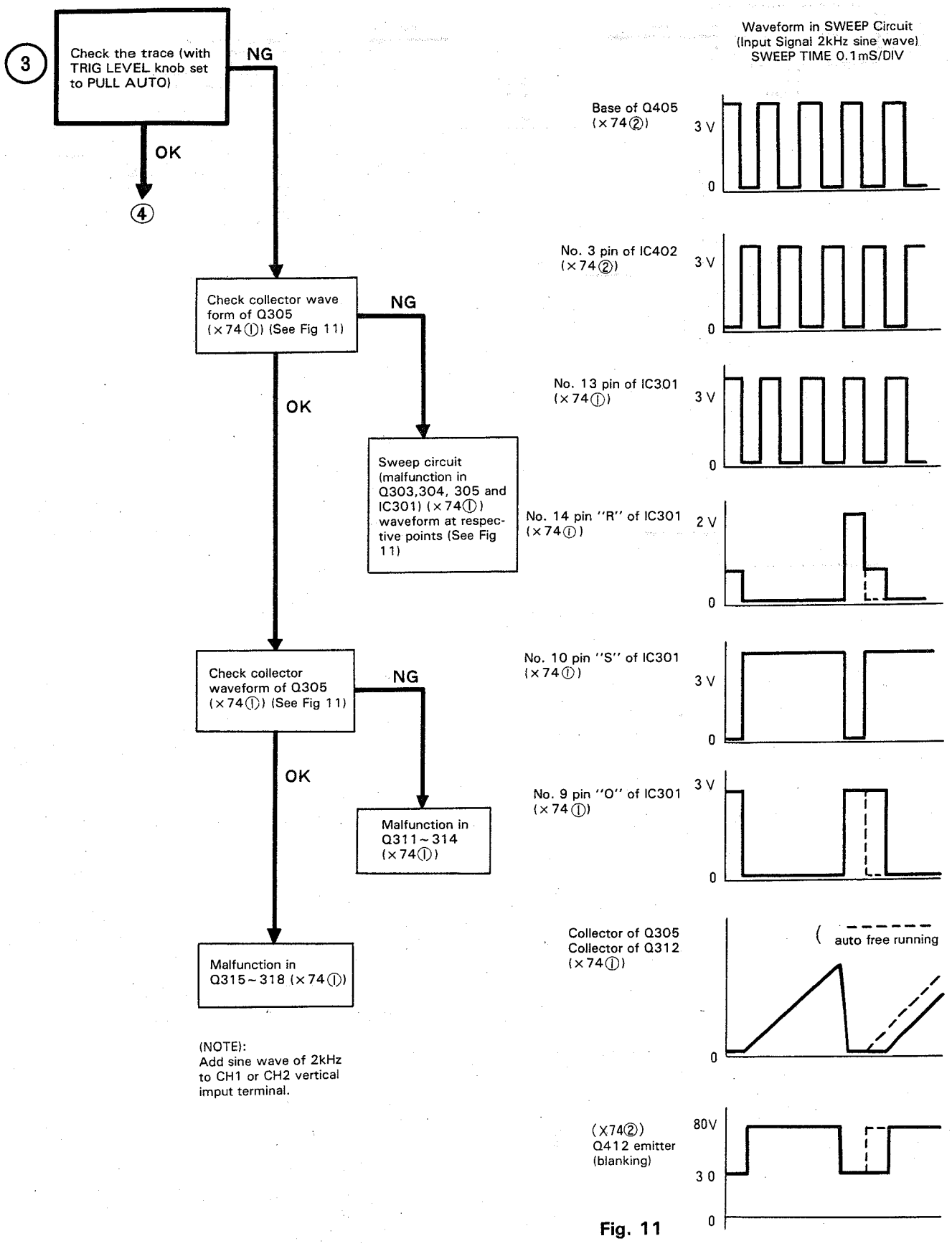
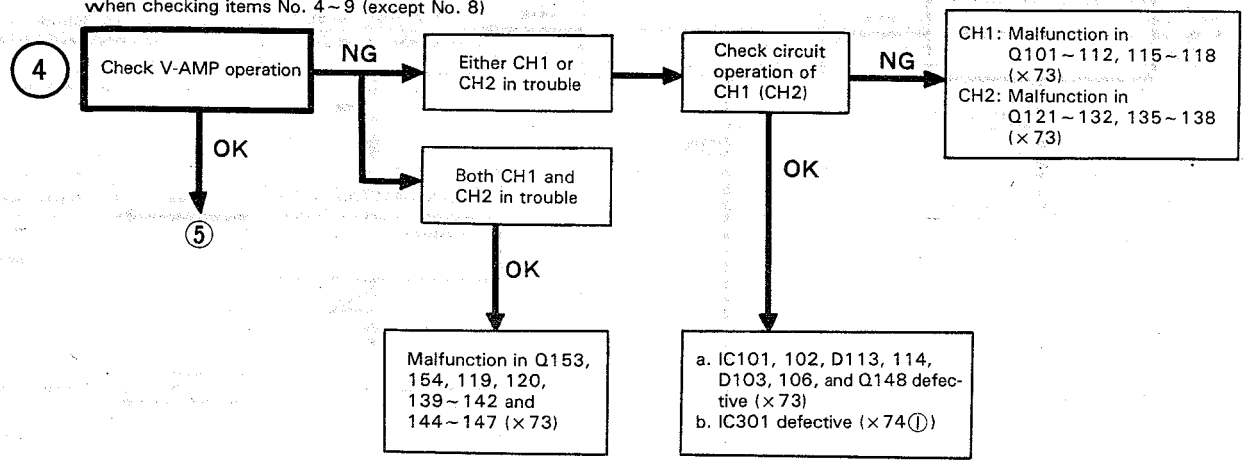
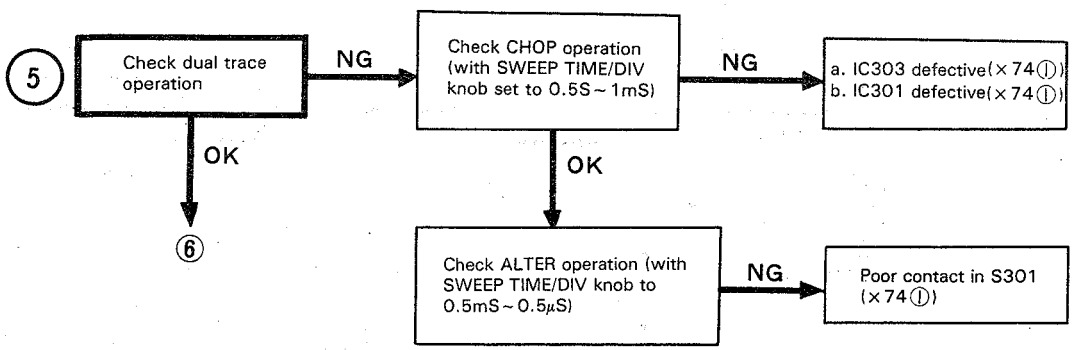
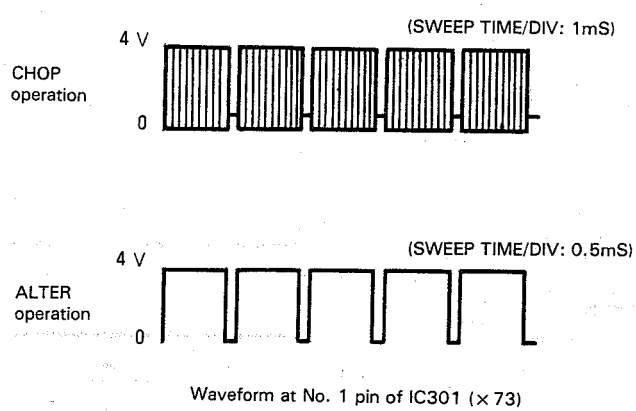

3
Check the trace (with TRIG LEVEL knob set to PULL AUTO)
NG
OK
④
Check collector wave form of Q305 (×74①) (See Fig 11)
NG
OK
Sweep circuit (malfunction in Q303,304, 305 and IC301) (×74①) waveform at respective points (See Fig 11)
Check collector waveform of Q305 (×74①) (See Fig 11)
NG
OK
Malfunction in Q311~314 (×74①)
Malfunction in Q315~318 (×74①)
(NOTE):
Add sine wave of 2kHz to CH1 or CH2 vertical imput terminal.
Waveform in SWEEP Circuit
(Input Signal 2kHz sine wave)
SWEEP TIME 0.1mS/DIV
Base of Q405 (×74②)
3 V
0
No. 3 pin of IC402 (×74②)
3 V
0
No. 13 pin of IC301 (×74①)
3 V
0
No. 14 pin "R" of IC301 (×74①)
2 V
0
No. 10 pin "S" of IC301 (×74①)
3 V
0
No. 9 pin "O" of IC301 (×74①)
3 V
0
Collector of Q305
Collector of Q312
(×74①)
(auto free running)
0
(X74②)
Q412 emitter
(blanking)
80V
3 0
0

Fig. 11

(NOTE): Add sine wave of 2kHz to CH1 or CH2 vertical input terminal when checking items No. 4~9 (except No. 8)

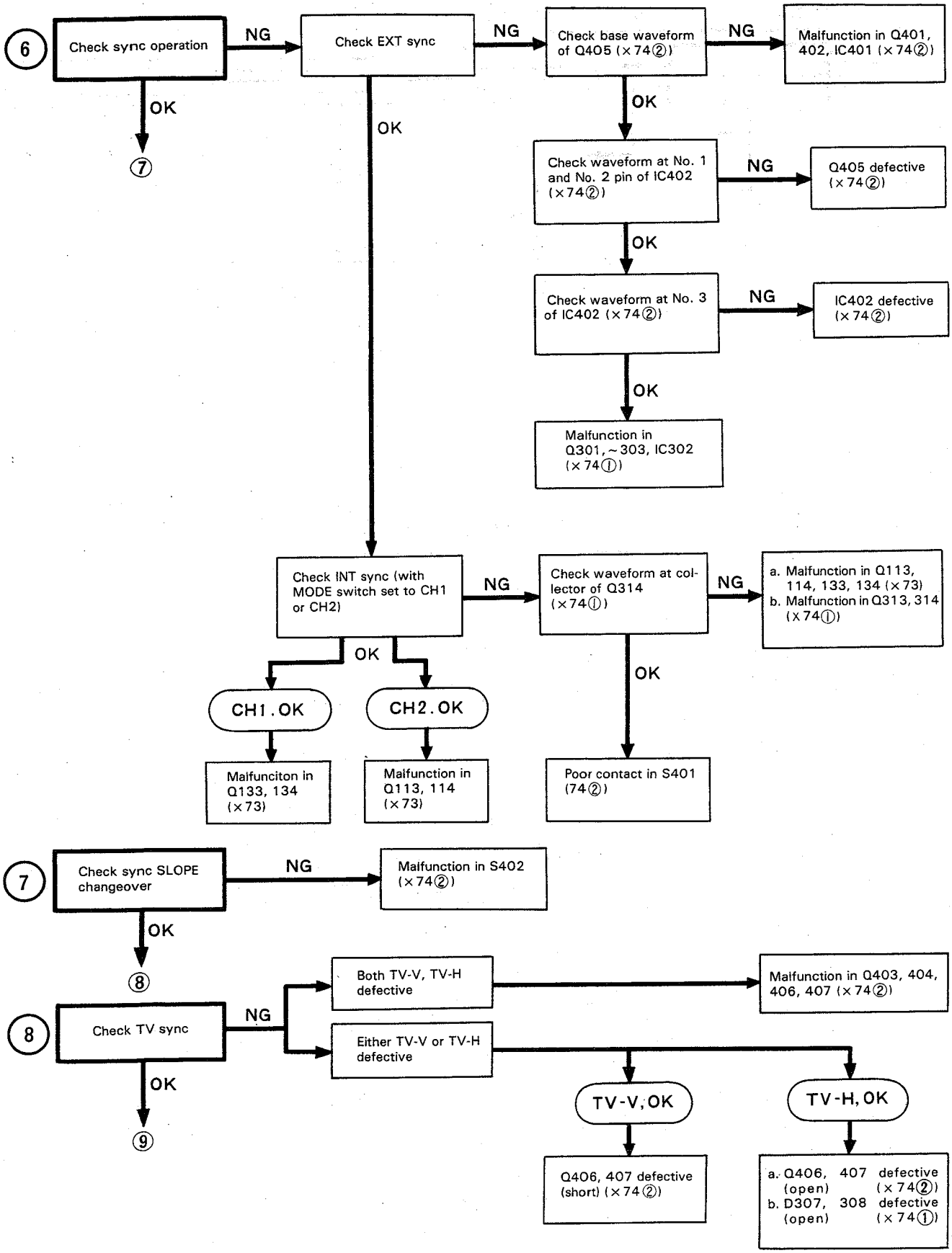

4
Check V-AMP operation
NG
Either CH1 or CH2 in trouble
Check circuit operation of CH1 (CH2)
NG
CH1: Malfunction in Q101~112, 115~118 (×73)
CH2: Malfunction in Q121~132, 135~138 (×73)
OK
5
Both CH1 and CH2 in trouble
OK
OK
Malfunction in Q153, 154, 119, 120, 139~142 and 144~147 (×73)
a. IC101, 102, D113, 114, D103, 106, and Q148 defective (×73)
b. IC301 defective (×74Ⓘ)



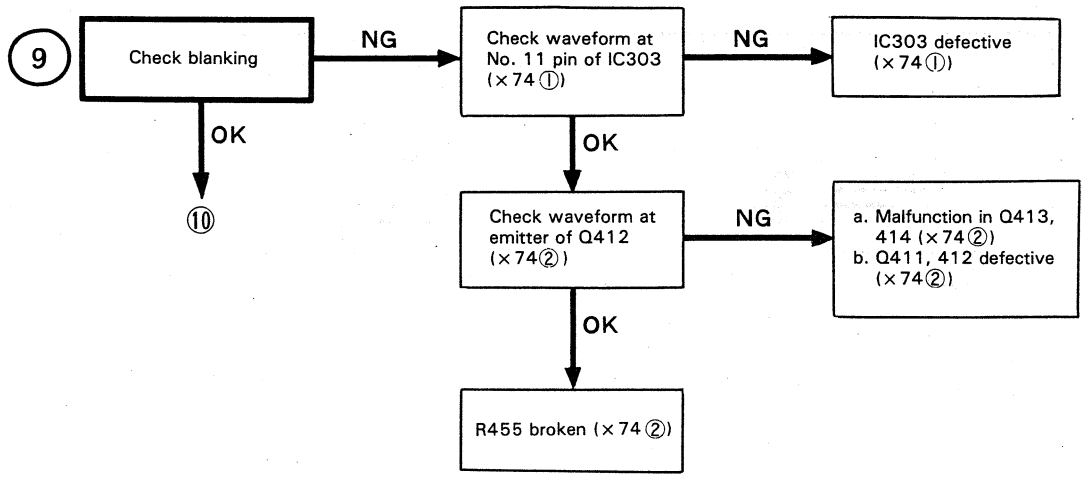


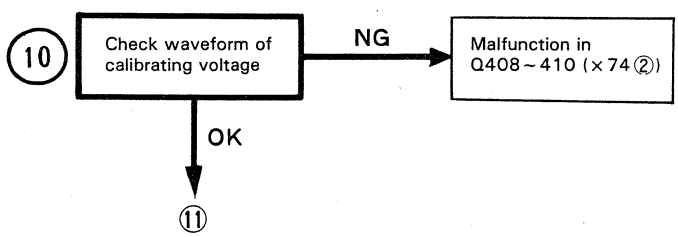
Waveform at No. 1 pin of IC301 (×73)

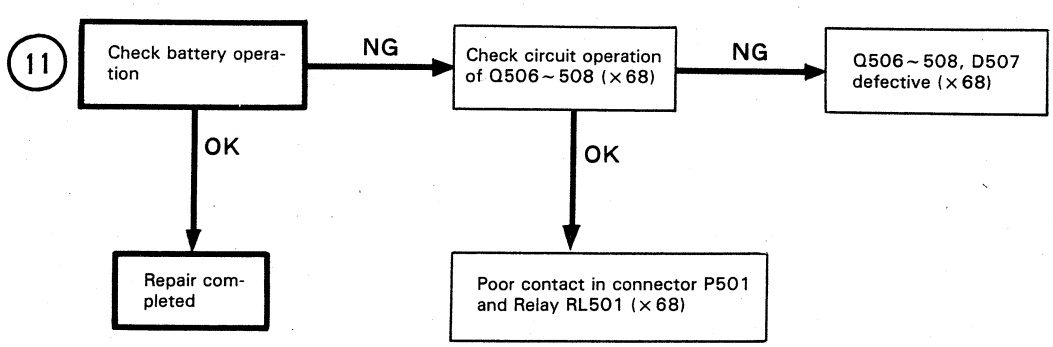
Fig. 12


6
Check sync operation
NG
Check EXT sync
NG
Check base waveform of Q405 (×74②)
NG
Malfunction in Q401, 402, IC401 (×74②)
OK
⑦
OK
OK
Check waveform at No. 1 and No. 2 pin of IC402 (×74②)
NG
Q405 defective (×74②)
OK
Check waveform at No. 3 of IC402 (×74②)
NG
IC402 defective (×74②)
OK
Malfunction in Q301, ~303, IC302 (×74①)
Check INT sync (with MODE switch set to CH1 or CH2)
NG
Check waveform at collector of Q314 (×74①)
NG
a. Malfunction in Q113, 114, 133, 134 (×73)
b. Malfunction in Q313, 314 (×74①)
OK
OK
CH1.OK
CH2.OK
Malfunciton in Q133, 134 (×73)
Malfunction in Q113, 114 (×73)
Poor contact in S401 (74②)
7
Check sync SLOPE changeover
NG
Malfunction in S402 (×74②)
OK
⑧
8
Check TV sync
NG
Both TV-V, TV-H defective
Malfunction in Q403, 404, 406, 407 (×74②)
Either TV-V or TV-H defective
OK
⑨
TV-V,OK
TV-H,OK
Q406, 407 defective (short) (×74②)
a. Q406, 407 defective (open) (×74②)
b. D307, 308 defective (open) (×74①)

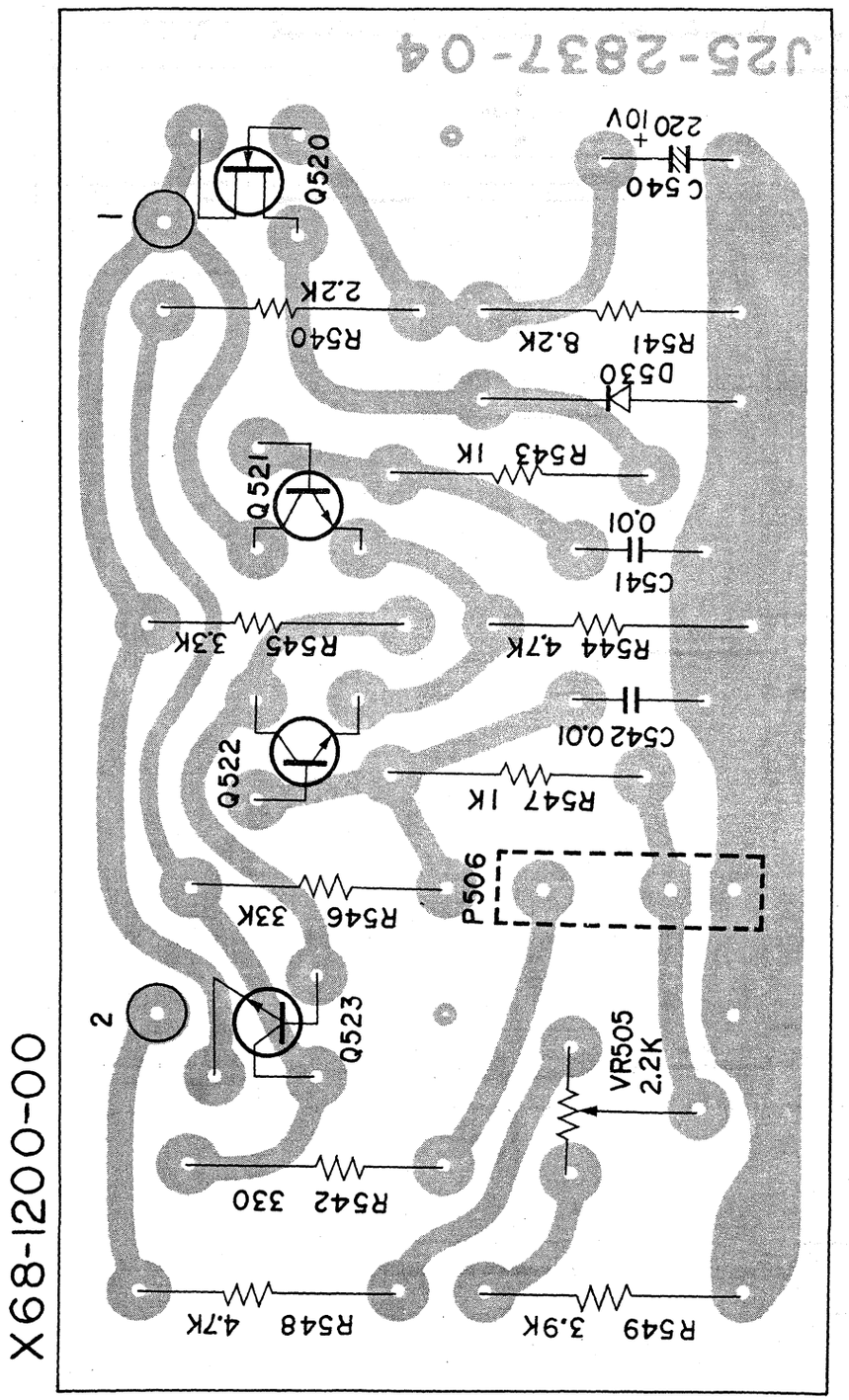
(NOTE): Add image signal from TV set to vertical input terminal.





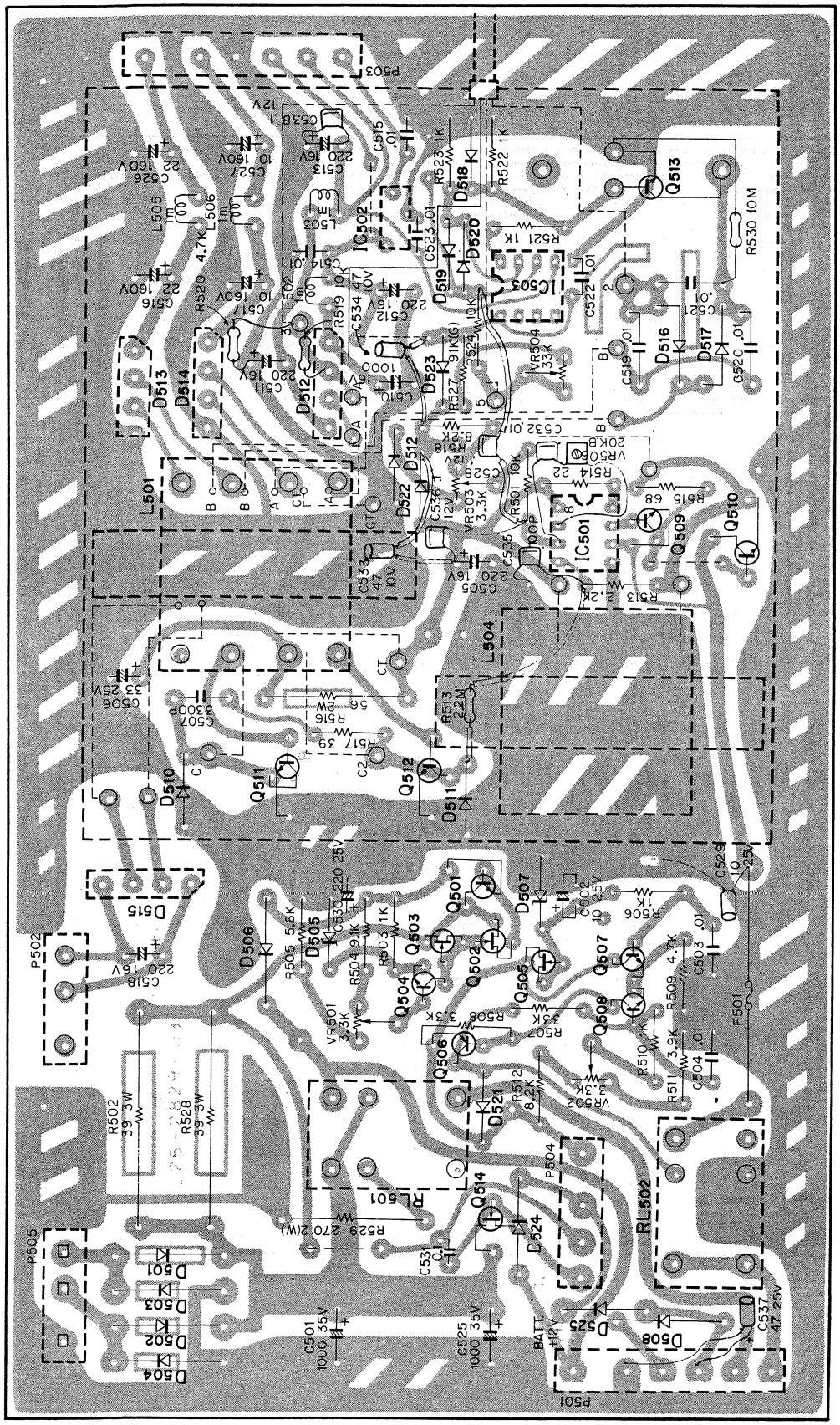


PC BOARD

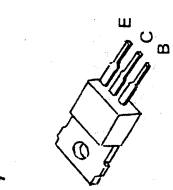


Effective serial number from 482001 to 482100

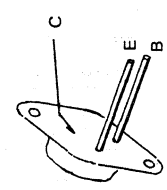
PC BOARD



IC501 :NJM305D, IC502 :NJM78L05/A, IC503 :NJM4558D
Q501 :2SD570(Q), Q502,504,507,508,521,522 :2SC945(P), Q503,505,520 :2SK30A(O), Q506,509,523 :2SA733(Q), Q510~512 :2SD731(Q)
Q513 :2SD470, Q514 :2SK19(BL)
D501~504,506 :U05B, D505,507,530 :WZ-050, D509 :T51B, D510,511,518~525 :1S1555, D512~515 :S1QB60, D516,517 :V11-N



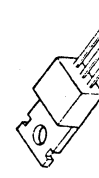
2SD731



2SD470

2SC945(P)
2SA733(O)

2SK30A(O)

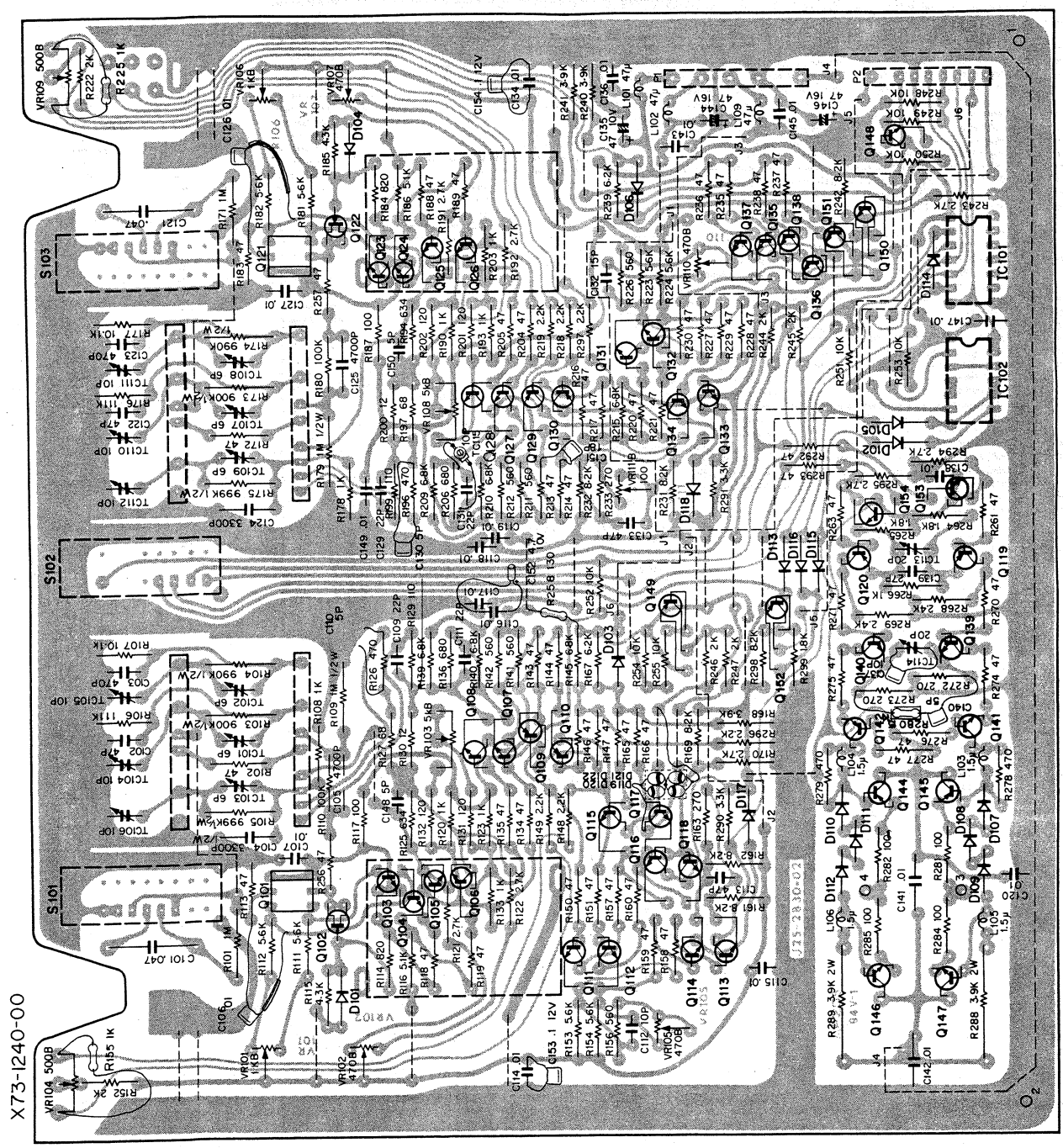


2SD570(Q)

2SK19(BL)

Effective serial number from 482001 to 482100

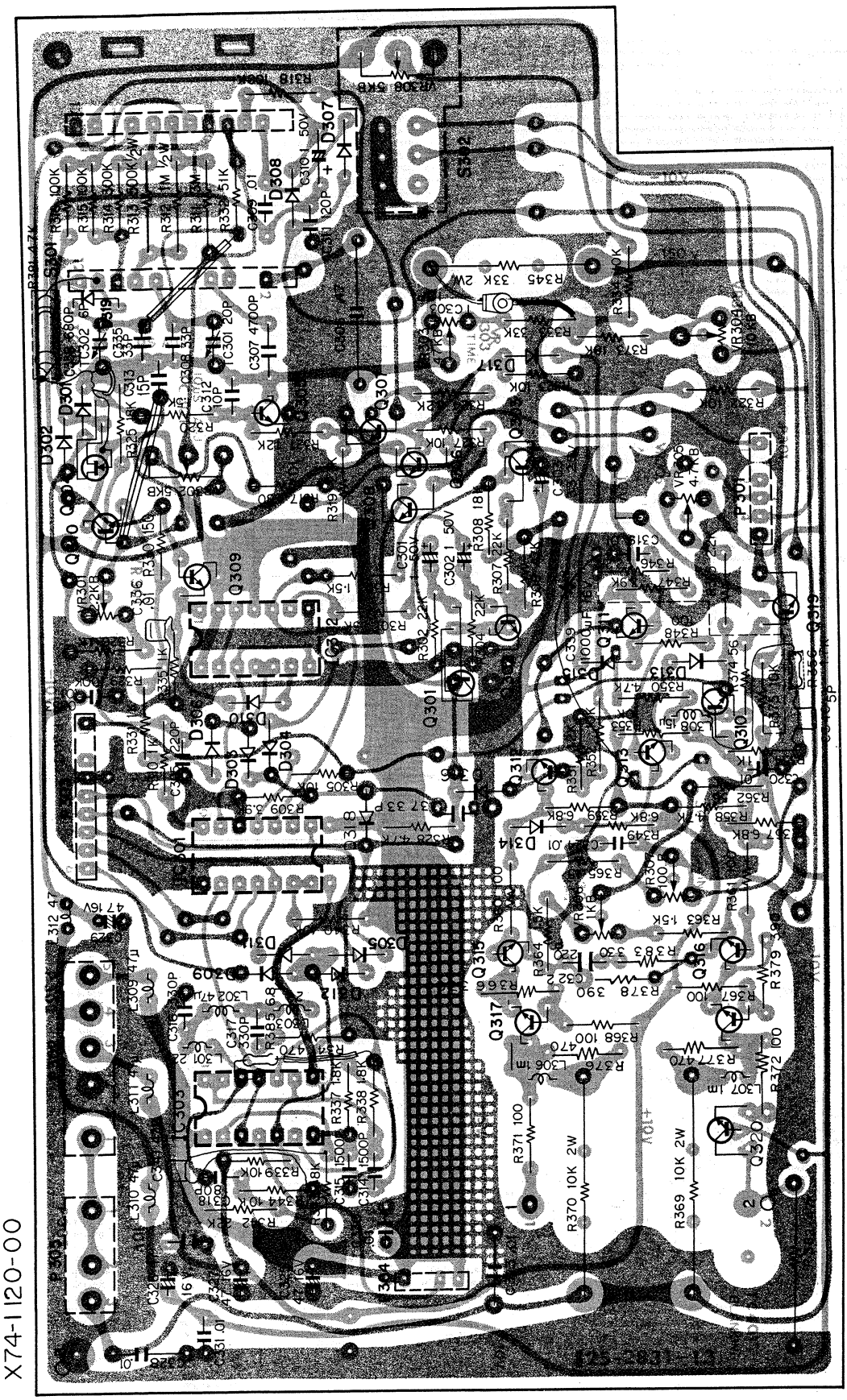
PC BOARD



X73-1240-00

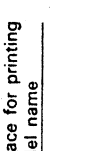
IC101, 102 : SN74LSOON Q101, 121 : 2SK58-1(M, N), Q102, 122 : 2SK30A(O), Q103~106, 123~126, 139, 140 : 2SC1047(C)
Q107, 108, 111~118, 127, 128, 131~138, 148, 150, 151, 153, 154 : 2SC1359(C) Q109, 110, 119, 120, 129, 130, 149, 152 : 2SA838(C) Q141, 142, 146, 147 : 2SC1953(R),
Q144, 145 : 2SA914(R) D101~106, 113~116 : 1S1555, D107~112 : 1S1587, D117, 118 : WZ-061

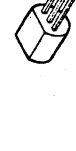
PC BOARD



X74-1120-00

IC301: SN74LS112N, IC302, 303: SN74LS00N
Q301~303, 305, 306, 308~316, 319: 2SC1359(C), Q304: 2SK30A(O), Q307: 2SA838(C), Q317, 318: 2SC1953(R)
D301, 302, 310: 1S1587, D303~309, 311~318: 1S1555, D317: WZ-081

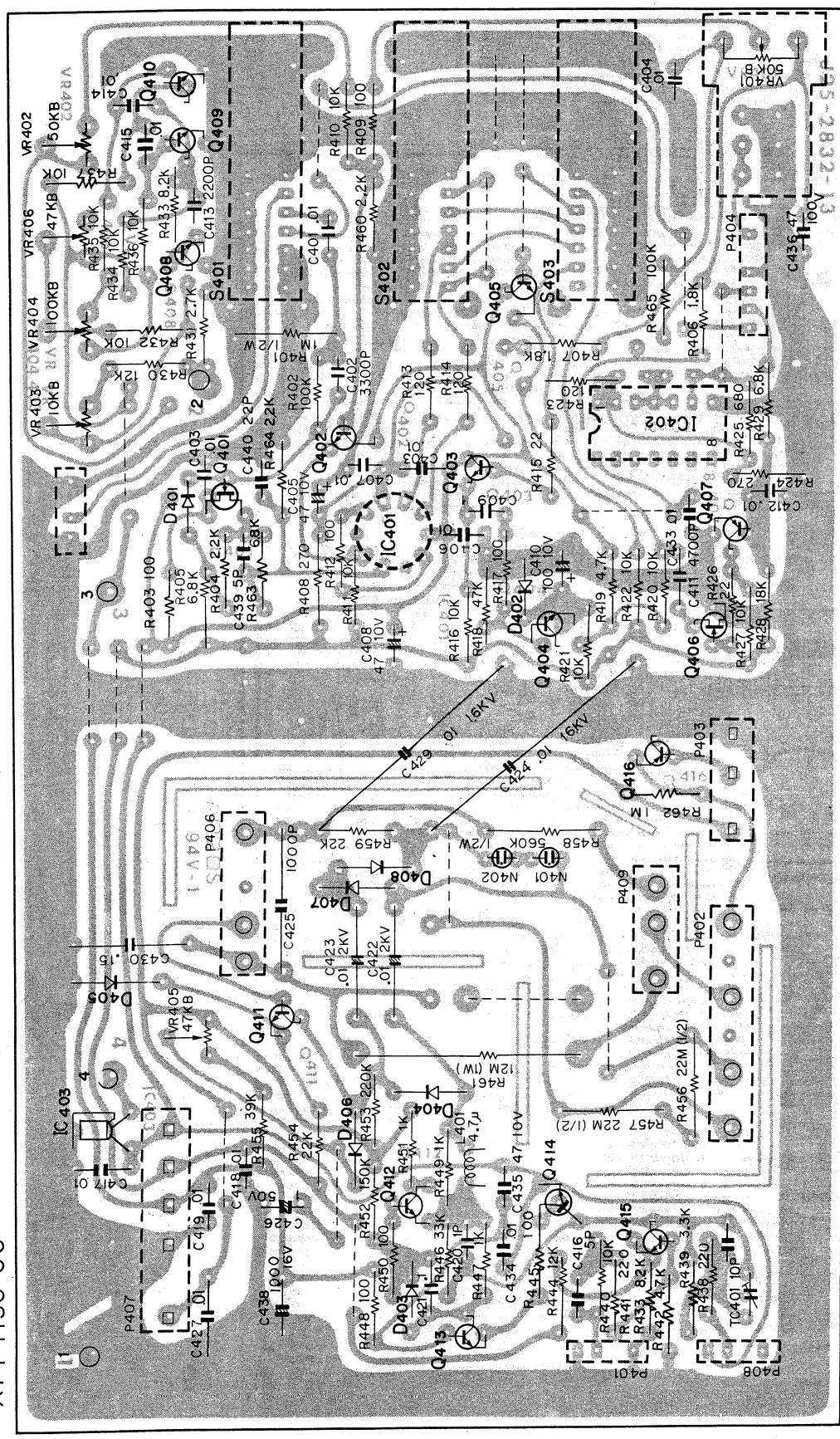




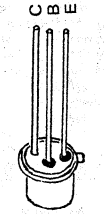
2SC1359(C)

PC BOARD

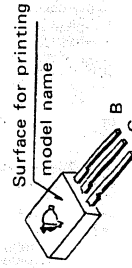
X74-1130-00



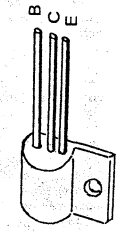
IC401:RC733T, IC402:SN74LSOON, IC403:NJM78L05/A
Q401,406:2SK30A(O), Q402~405,408~410,414,415:2SC983(Y), Q407:2SA838C, Q411~413:2SC983(Y), Q416:2SA914(R)
D401,402,405:1S1555, D403:WZ-050, D404:1S1705, D406~408:W06C



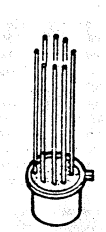
2SC983(Y)



2SC914(R)



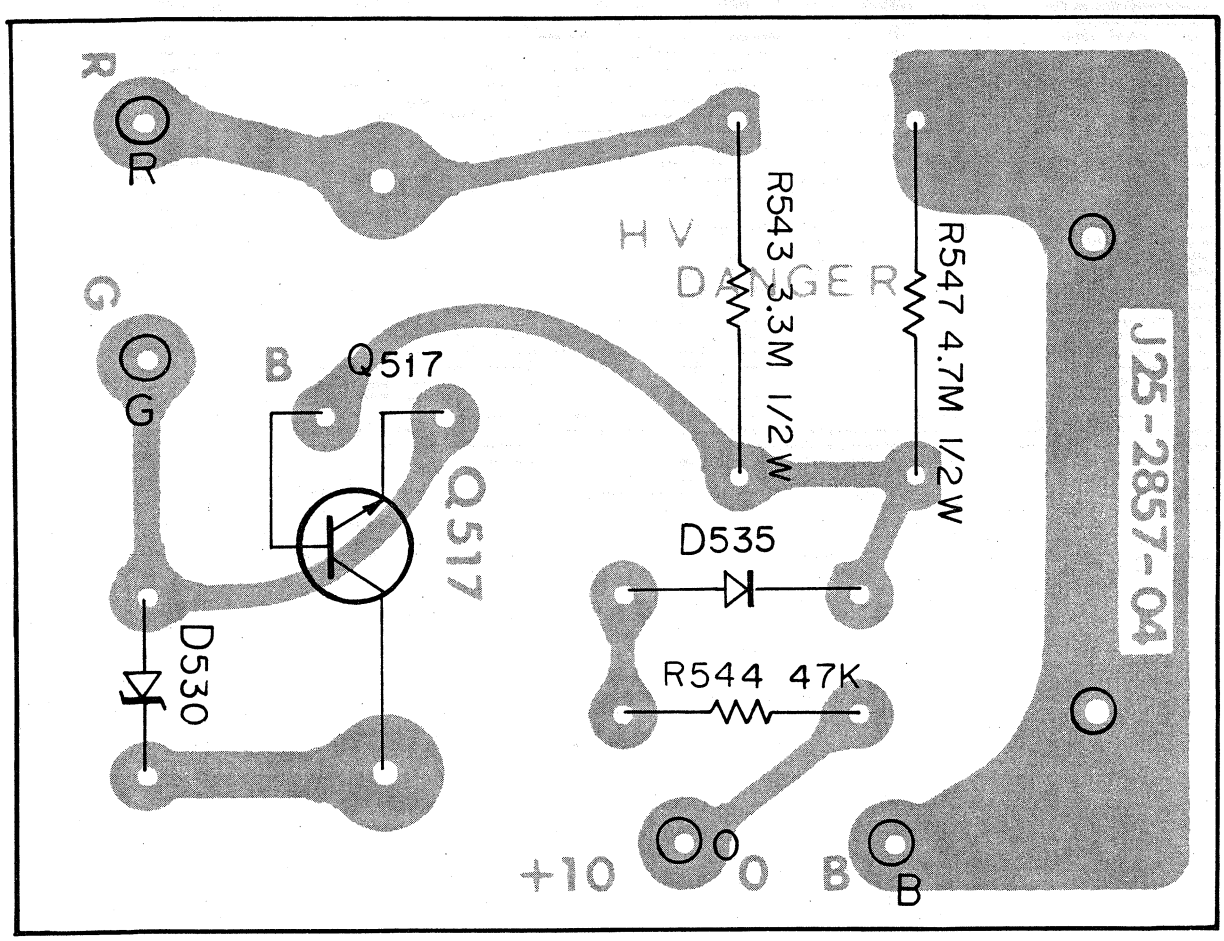
2SC1407(C)



RC733T

PC BOARD

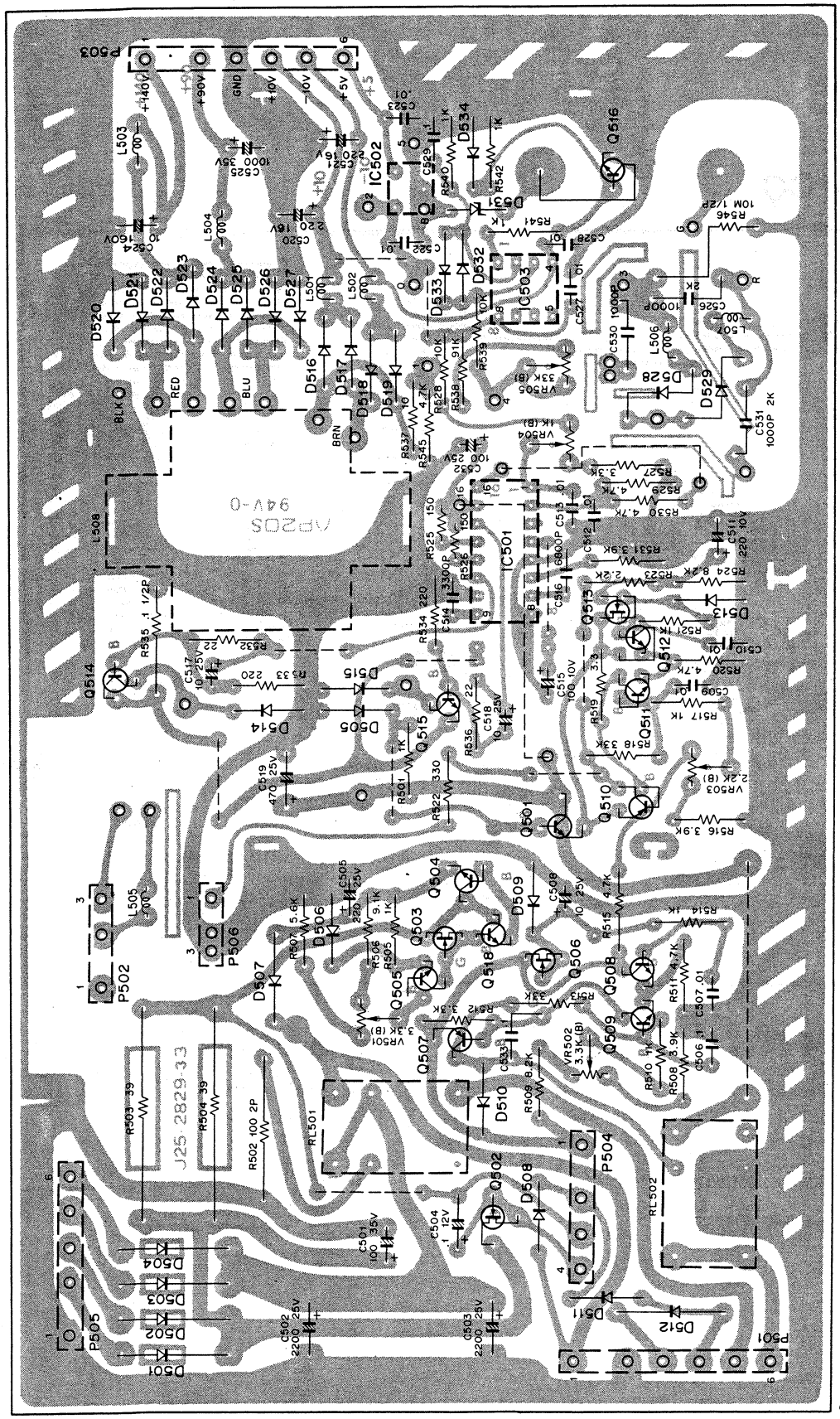
X68-1250-00



Q517 : 2SD470, D530 : U05B, D535 : V11N

Effective serial number from 482101 up

PC BOARD



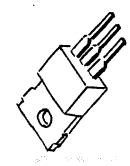
X68-1250-00

Q501,505,508,509,511,512,518 : 2SC945 (P)
Q502 : 2SK19 (BL)
Q503,506,513 : 2SK30A (O)
Q504 : 2SD570 (Q)
IC501 : SG3524N
IC502 : NJM78L05/A

Q507,510 : 2SA733
Q514,515 : 2SC1816 (3)
Q516,517 : 2SD470
IC503 : NJM4558D

D501~504,507,512 : U05B
D505 : WZ-081
D506,509,513 : WZ-050
D508,510,511,514,515,532~534 : 1S1555

D516~527,535 : V11-N
D528,529 : Y16JA
D530,531 : C10DK102



2SC1816(3)

Effective serial number from 482101 up

PARTS LIST

TOTAL (Y70-1181-60)

Ref. No.	Parts No.	Description
R1,2	RD14BB2E471J	Carbon 470 Ω ±5% 1/4 W
VR1	R01-6003-05	Variable resistor 250 kΩB
VR2	R05S-8001-05	Variable resistor 3 MΩ
VR3(S1)	R03-1021-05	Variable resistor with switch 1 kΩB
	MISCELLANEOUS	
–	A01-0824-32	Case
–	A10-1421-22	Chassis (1)
–	A10-1422-12	Chassis(1)
–	A20-2723-22	Panel
–	A21-0834-14	Ornamental panel (H)
–	A21-0835-03	Ornamental panel (V)
–	A23-1613-23	Rear panel
–	B20-0908-04	Graticule
–	B30-0905-05	Lamp assembly
–	B30-0906-35	Lamp assembly
–	B40-0765-04	Name plate
–	B41-0717-04	Name plate (power source)
–	B41-0710-04	Name plate
–	B42-1811-04	Name plate (How to install the optional battery pack)
–	B50-2853-00	Instruction manual
–	D32-0501-04	Stopper
–	E01-1403-05	CRT socket
–	E03-0201-05	Power connector
–	E03-0202-05	Power jacket (external power)
–	E04-0251-05	BNC receptacle
–	E08-1081-05	Voltage selector, receptacle
–	E09-0681-05	Voltage selector, plug
–	E09-0203-25	Connector plug
–	E13-0101-05	Pin jack
–	E14-0101-05	Pin plug
–	E21-0654-04	Terminal "CAL 1 Vp-p"
–	E30-1818-05	Input cord
–	E23-0516-04	Grounding plate
–	E23-0513-05	Grounding lug
J1	E31-0547-25	Lead wire with connector
J2	E31-0548-25	Lead wire with connector
J3	E31-0549-25	Lead wire with connector
J4	E31-0550-25	Lead wire with connector
J6	E31-0552-15	Lead wire with connector
J7	E31-0553-15	Lead wire with connector
J8	E31-0554-15	Lead wire with connector
J9	E31-0555-15	Lead wire with connector
J11	E31-0556-15	Lead wire with connector
J12	E31-0557-25	Lead wire with connector
J13	E31-0558-15	Lead wire with connector
J14	E31-0559-15	Lead wire with connector
J15~18	E30-0481-35	Lead wire with connector
J19	E31-0560-15	Lead wire with connector
J21,22	E31-0562-05	Lead wire with connector
J23,24	E31-0563-05	Lead wire with connector
J25	E31-0481-35	Lead wire with connector
J26	E31-0564-05	Lead wire with connector
–	F05-5013-05	Fuse 0.5 A×3
–	F05-1023-05	Fuse 1 A×2
–	F10-1520-23	Shielding plate
–	F10-1522-32	Shielding plate
–	F11-0917-03	CRT shield
–	F15-0706-04	Blinding plate
–	F19-0125-14	Scotchical sheet
–	F19-0703-04	Patch, for voltage selector ×3
–	F20-0605-32	Insulating plate
–	F20-0607-04	Insulating sheet
–	F20-0608-04	Insulating sheet
–	F20-0609-04	Insulating sheet
–	G01-0904-04	Spring
–	G02-0601-14	Plate spring
–	G13-0090-04	CRT mounting rubber ×2
–	G13-0703-14	Cushion ×4
–	H01-2838-24	Packing case (individual packing)
–	H10-2803-32	Packing material, foamed styren (front)
–	H10-2804-22	Packing material, foamed styren (rear)
–	H20-1708-14	Protection cover
–	H25-0029-04	Polyethylene bag
–	J03-0003-04	Rubber leg ×4
–	J19-1611-04	CRT band
–	J13-0033-15	Fuse holder
–	J21-0392-04	Wire holder
–	J21-2805-05	Grip mounting hardware ×2
–	J21-2849-33	P.C. Board mounting hardware
–	J21-2850-14	CRT mounting hardware
–	J21-2866-04	P.C. Board mounting hardware
–	J42-0038-04	Hole bush (B) ×7
–	J42-0504-04	Bush
–	J61-0039-05	Wire clip
–	J61-0049-05	Cable wrapping band ×15
–	J61-0019-05	Vinyl tie
–	K01-0502-05	Grip assembly
–	K01-0504-05	Grip (metallic)
–	K01-0505-05	Grip (molded)
–	K21-0259-14	Knob 22.8 φ ×3
–	K21-0280-04	Knob 11 φ ×7
–	K21-0801-14	Knob 13 φ ×3
–	K23-0147-04	Knob, for lever switch ×3
–	K29-0801-14	Knob, for lever switch ×3
–	L01-9176-05	Power transformer
L1,2	L40-1591-41	Ferri-inductor 1.5μH
–	W01-0058-03	Cord winder ×4
		CRT C331P31B
–	X68-1250-00	Power supply unit
–	X73-1240-00	Vertical amplifier unit

PARTS LIST

Ref. No.	Parts No.	Description
–	X74-1120-00	Sweep circuit unit
–	X74-1130-00	Trigger, blanking unit
–	Y87-1250-00	Probe (PC-29) ×2
–	Y87-1290-00	Hood assembly

* POWER SUPPLY CIRCUIT UNIT (X68-1250-00)

Ref. No.	Parts No.	Description
	RESISTOR	
–	R92-0150-05	Jumper resistor
R501	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R502	RS14GB3D101J	Metal film 100Ω ±5% 2W
R503,504	RS14GB3F390J	Metal film 39Ω ±5% 2W
R505	RD14BB2E102J	Carbon 1kΩ ±5% 1/4 W
R506	RN14BK2E9101G	Metal film 9.1kΩ ±2% 1/4W
R507	RN14BK2E5601G	Metal film 5.6kΩ ±2% 1/4W
R508	RN14BK2E3901G	Metal film 3.9kΩ ±2% 1/4W
R509	RN14BK2E8201G	Metal film 8.2kΩ ±2% 1/4W
R510	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R511	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R512	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R513	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R514	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R515	RN14BK2E4701G	Metal film 4.7kΩ ±2% 1/4W
R516	RN14BK2E3901G	Metal film 3.9kΩ ±2% 1/4W
R517	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R518	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R519	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R520	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R521	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R522	RD14BB2E331J	Carbon 330Ω ±5% 1/4W
R523	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R524	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R525,526	RD14CB2E151J	Carbon 150Ω ±5% 1/4W
R527	RN14BK2E3301G	Metal film 3.3kΩ ±2% 1/4W
R528	RN14BK2E1002G	Metal film 10kΩ ±2% 1/4W
R529,530	RN14BK2E4701G	Metal film 4.7kΩ ±2% 1/4W
R531	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R532	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R533,534	RD14BB2ED221J	Carbon 220Ω ±5% 1/4W
R535	R92-0758-05	Metal film 0.1Ω 1/2P
R536	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R537	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R538	RN14BK2E9102G	Metal film 91kΩ ±2% 1/4W
R539	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R540~542	RN14BB2E102J	Metal film 1kΩ ±5% 1/4W
R543	RC05GF2H335J	Solid 3.3MΩ ±5% 1/2W
R544	RD14BB2E473J	Carbon 47kΩ ±5% 1/4W
R545	RD14BB2E472J	Cab ron 4.7kΩ ±5% 1/4W
R546	RC05GF2H106J	Solid 10MΩ ±5% 1/2W
R547	RC05GF2H475J	Solid 4.7MΩ ±5% 1/2W
VR501,502	R12-1037-05	Semi fixed resistor 3.3kΩB
VR503	R12-1003-05	Semi fixed resistor 2.2kΩB
VR504	R12S-1029-05	Semi fixed resistor 1kΩB
VR505	R12-3502-05	Semi fixed resistor 33kΩB
	CAPACITOR	
C501	CE04W1V101	Electrolytic 100μF 35WV
C502,503	CE04W1E222	Electrolytic 2,200μF 25WV
C504	C90-0298-05	Semi-conductor ceramic 0.1μF +80%, −20%
C505	CE04W1E221	Electrolytic 220μF 25WV
C506,507	CK45D1H103M	Ceramic 0.01μF ±20%
C508	CE04W1E100	Electrolytic 10μF 25WV
C509,510	CK45D1H103M	Ceramic 0.01μF ±20%
C511	CE04W1A221	Electrolytic 220μF 10WV
C512,513	CK45D1H103M	Ceramic 0.01μF ±20%
C514	CK45D1H332M	Ceramic 3300pF ±20%
C515	CE04W1A101	Electrolytic 100μF 10WV
C516	CQ93M1H682K	Mylar 6800pF ±10%
C517,518	CE04W1E100	Electrolytic 10μF 25WV
C519	CE04W1E471	Electrolytic 470μF 25WV
C520,521	CE04W1C221	Electrolytic 220μF 16WV
C522,523	CK45D1H103M	Ceramic 0.01μF ±20%
C524,525	CE04W2C100	Electrolytic 10μF 160 WV
C526	CK45E3F102P	Ceramic 1000pF +100%, −0%
C527,528	CK45D1H103M	Ceramic 0.01μF ±20%
C529	C90-0298-05	Semi-conductor resistor 0.1μF +80%, −20%
C530,531	CK45E3F102P	Ceramic 1000pF +100%, −0%
C532	CE04W1E101	Electrolytic 100μF 25WV
C533	C90-0298-05	Semi-conductor resistor 0.1μF +80%, −20%
	SEMICONDUCTOR	
IC501		IC SG3524N
IC502		IC NJM78L05/A
IC503		IC NJM4558D
Q501		Transistor 2SC945(P)
Q502		FET 2SK19(BL)
Q503		FET 2SK30A(O)
Q504		Transistor 2SD570(Q)
Q505		Transistor 2SC945(P)
Q506		FET 2SK30A(O)
Q507		Transistor 2SA733(Q)
Q508,509		Transistor 2SC945(P)
Q510		Transistor 2SA733(Q)
Q511,512		Transistor 2SC945(P)
Q513		FET 2SK30A(O)
Q514,515		Transistor 2SC1816(3)
Q516,517		Transistor 2SD470
Q518		Transistor 2SC945(P)
D501~504		Diode U05B
D505		Zener diode WZ-081
D506		Zener diode WZ-050
D507		Diode U05B
D508		Diode ISI555
D509		Zener diode WZ-050
D510,511		Diode ISI555

* Effective serial number from 482101 up

PARTS LIST

Ref. No.	Parts No.	Description
D512		Diode U05B
D513		Zener diode WZ-050
D514,515		Diode ISI555
D516~527		Diode (High voltage) V11-N
D528,529		Diode (High voltage) Y16JA
D530,531		Surge absorber C10DK102
D532~534		Diode ISI555
D535		Diode (High voltage) V11-N
	MISCELLANEOUS	
—	E31-0551-15	Lead wire with connector
—	E31-0578-05	Lead wire with terminal
P501	E40-0632-05	Pin connector
P502	E40-0372-05	Pin connector
P503	E40-0632-05	Pin connector
P504	E40-0432-05	Pin connector
P505	E40-0532-05	Pin connector
P506	E40-0313-05	Pin connector
—	F01-0815-14	Heat sink
—	J21-2889-04	P.C. board mounting hardware
—	F11-0918-33	Shielding case(1)
—	F11-0919-14	Shielding case (2)
—	F12-0501-04	Flexible tube
—	J25-2829-33	Printed circuit board
—	J25-2857-04	Printed circuit board
—	J42-0505-05	Bush
L501	L40-4711-03	Ferri-inductor 4.7 μH
L502	L40-5611-03	Ferri-inductor 5.6 μH
L503	L40-3335-06	Ferri-inductor 3.3 μH
L504	L40-2235-06	Ferri-inductor 2.2 μH
L505	L40-3311-03	Ferri-inductor 3.3 μH
L506,507	L40-2235-05	Ferri-inductor 2.2 μH
L508	L19-0406-15	DC-DC converter transformer
RL501,502	S51-1505-05	Relay ×2

SWEEP CIRCUIT UNIT (X74-1120-00)

Ref. No.	Parts No.	Description
	RESISTOR	
R301	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R302	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R303	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R304	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R305	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R306	RD14BB2E473J	Carbon 47kΩ ±5% 1/4W
R307	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R308	RD14BB2E183J	Carbon 18kΩ ±5% 1/4W
R309	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R310	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R311	R92-0709-05	Metal film 3MΩ ±1% 1/4W
R312	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R313	RN14BK2H5003F	Metal film 500kΩ ±1% 1/2W
R314	RN14BK2E3003F	Metal film 300kΩ ±1% 1/4W
R315,316	RN14BK2E1003F	Metal film 100kΩ ±1% 1/4W
R317	RD14BB2E681J	Carbon 680Ω ±5% 1/4W
R318	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R319	RD14BB2E272J	Carbon 2.7kΩ ±5% 1/4W
R320	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R321	RD14BB2E123J	Carbon 12kΩ ±5% 1/4W
R322,323	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R324	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R325	RD14BB2E183J	Carbon 18kΩ ±5% 1/4W
R326	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R327	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R328	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R329	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R330	RD14BB2E151J	Carbon 150Ω ±5% 1/4W
R331	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R332	RN14BK2E5102G	Metal film 51kΩ ±2% 1/4W
R333	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R334	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R335	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R337,338	RD14BB2E182J	Carbon 1.8kΩ ±5% 1/4W
R339,340	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R341	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R342	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R343	RD14BB2E182J	Carbon 1.8kΩ ±5% 1/4W
R344	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R345	RS14GB3D333J	Metal film 33kΩ ±5% 2W
R346	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R347	RD14BB2E392J	Carbon 3.9Ω ±5% 1/4W
R348	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R349	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R350	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R351	RD14BB2E122J	Carbon 1.2kΩ ±5% 1/4W
R352,353	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R354	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R355	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R356	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R357	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R358	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R359	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R360,361	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R362	RD14BB2E560J	Carbon 56Ω ±5% 1/4W
R363,364	RN14BK2E1501G	Metal film 1.5kΩ ±2% 1/4W
R365	RD14BB2E150J	Carbon 15Ω ±5% 1/4W
R366	RN14BK2E5100G	Metal film 510Ω ±2% 1/4W
R367,368	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R369,370	RS14GB3D103J	Metal film 10kΩ ±5% 2W
R371,372	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R373	RD14BB2E183J	Carbon 18kΩ ±5% 1/4W
R374	RD14BB2E560J	Carbon 56Ω ±5% 1/4W
R375	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R376,377	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R378,379	RD14BB2E391J	Carbon 390Ω ±5% 1/4W
R381,382	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R383	RD14BB2E331J	Carbon 330Ω ±5% 1/4W
R384	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W

PARTS LIST

Ref. No.	Parts No.	Description
R385	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
VR301	R12-1003-05	Semi-fixed resistor 2.2 kΩB
VR302	R01-2501-05	Semi-fixed resistor with switch 5kΩB
VR303	R12-3004-05	Semi-fixed resistor 47kΩB
VR304	R12-3002-05	Semi-fixed resistor 10kΩB
VR305	R12-1004-05	Semi-fixed resistor 4.7kΩ
VR306	R12-1002-05	Semi-fixed resistor 1kΩB
VR307	R12-0056-05	Semi-fixed resistor 100ΩB
VR308	R01-2504-05	Semi-fixed resistor with switch 5kΩB
	CAPACITOR	
C301,302	CE04W1H010	Electrolytic 1μF 50WV
C303	CE04W1E3R3	Electrolytic 3.3μF 25WV
C305	CC45SL1H221J	Ceramic 220pF ±5%
C306	C91-0517-05	Mylar 0.47μF ±10%
C307	C91-0516-05	Mylar 4700pF ±10%
C308	CM93BD2A330J	Mica 33pF ±5%
C309	CQ93M1H103K	Mylar 0.01μF ±10%
C310	CE04BW1H010M	Electrolytic 1μF 50WV
C311	CC45CH1H331J	Ceramic 330pF ±5%
C312	CC45CH1H100D	Ceramic 10pF ±0.5pF
C313	CC45CH1H150J	Ceramic 15pF ±5%
C314,315	CQ93M1H152K	Mylar 1500pF ±10%
C316,317	CK45B1H331K	Ceramic 330pF ±10%
C318	CC45SL1H181J	Ceramic 180pF ±5%
C319,320	CK45D1H103M	Ceramic 0.01μF ±20%
C322	CK45B1H221K	Ceramic 220pF ±10%
C323	CK45D2H103M	Ceramic 0.01μF ±20%
C324	CK45D1H103M	Ceramic 0.01μF ±20%
C325~327	CE04W1C470	Electrolytic 47μF 16WV
C328	CK45D2H103M	Ceramic 0.01μF ±20%
C329	CE04W1C470	Electrolytic 47μF 16WV
C330~333	CK45D1H103M	Ceramic 0.01μF ±20%
C335	CM93BD2A330J	Mica 33pF ±5%
C336	CK45D1H103M	Ceramic 0.01μF ±20%
C337	CC45CH1H330J	Ceramic 33pF ±5%
C338	CM93BD2A681J	Mica 680pF ±5%
C339	CE04W1C102	Electrolytic 1000μF 16WV
C340	CC45CH1H050D	Ceramic 5pF ±0.5pF
C341	CC45SL1H470J	Ceramic 47pF ±5%
TC301	C05-0405-05	Ceramic trimmer 20pF
TC302	C05-0403-05	Ceramic trimmer 6pF
TC303	C05-0066-05	Ceramic trimmer 10pF
	SEMICONDUCTOR	
IC301		IC SN74LS112N
IC302,303		IC SN74LS00N
Q301~303		Transistor 2SC1359(C)
Q304		FET 2SK30A(O)
Q305,306		Transistor 2SC1359(C)
Q307		Transistor 2SA838(C)
Q308~316		Transistor 2SC1359(C)
Q317,318		Transistor 2SC1953(R)
Q319		Transistor 2SC1359(C)

Ref. No.	Parts No.	Description
D301,302		Diode 1S1587
D303~309		Diode 1S1555
D310		Diode 1S1587
D311~316		Diode 1S1555
D317		Zener diode WZ-081
D318		Diode 1S1555
D319		Diode 1S1587
	MISCELLANEOUS	
–	A22-0808-14	Sub-panel (H)
–	E02-0127-05	IC socket 14P
–	E02-0129-05	IC socket 16P
–	E23-0047-04	Terminal
–	E23-0502-04	Crounding plate
P301	E40-0513-05	Connector 5P
P302	E40-0532-05	Connector 5P
P303	E40-0813-05	Connector 8P
P304	E40-0313-05	Connector 3P
–	J25-2831-13	Printed circuit board
L301,303	L40-2201-03	Ferri-inductor 22μH
L302	L40-4701-03	Ferri-inductor 47μH
L308	L40-1501-03	Ferri-inductor 15μH
L306,307	L40-1025-04	Ferri-inductor 1mH
L309~312	L40-4701-03	Ferri-inductor 47μH
S301	S29-2506-05	Rotary switch

TRIGGER BLANKING UNIT (X74-1130 -00)

Ref. No.	Parts No.	Description
	RESISTOR	
R401	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R402	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R403	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R404	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R405	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R406	RD14BB2E182J	Carbon 1.8kΩ ±5% 1/4W
R409	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R410,411	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R412	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R413,414	RD14BB2E121J	Carbon 120Ω ±5% 1/4W
R415	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R416	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R417	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R418	RD14BB2E473J	Carbon 47kΩ ±5% 1/4W
R419	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R420~422	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R423	RD14BB2E181J	Carbon 180Ω ±5% 1/4W
R424	RD14BB2E271J	Carbon 270Ω ±5% 1/4W
R425	RD14BB2E681J	Carbon 680Ω ±5% 1/4W
R426	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R427	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R428	RD14BB2E183J	Carbon 18kΩ ±5% 1/4W

PARTS LIST

Ref. No.	Parts No.	Description
R429	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R430	RD14BB2E123J	Carbon 12kΩ ±5% 1/4W
R431	RD14BB2E272J	Carbon 2.7kΩ ±5% 1/4W
R432	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R433	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R434	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R435,436	RD14BB2E183J	Carbon 18kΩ ±5% 1/4W
R437	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R438	RD14BB2E221J	Carbon 220Ω ±5% 1/4W
R439	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R440	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R441	RD14BB2E221J	Carbon 220Ω ±5% 1/4W
R442	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R443	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R444	RD14BB2E123J	Carbon 12kΩ ±5% 1/4W
R445	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R446	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R447	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R448	RD14B B2E101J	Carbon 100Ω ±5% 1/4W
R449	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R450	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R451	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R452	RD14BB2E154J	Carbon 150Ω ±5% 1/4W
R453	RD14BB2E224J	Carbon 220kΩ ±5% 1/4W
R454	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R455	RD14BB2E393J	Carbon 39kΩ ±5% 1/4W
R456,457	RC05GF2H226K	Solid 22MΩ ±10% 1/2W
R458	RN14BK2H5603G	Metal film 560kΩ ±2% 1/2W
R459	RD14BB2E223J	Carbon 22kΩ ±5% 1/4W
R460	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R461	R92-0746-05	Metal film 12MΩ ±5% 1W
R462	RD14BB2E105J	Carbon 1MΩ ±5% 1/4W
R463	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R464	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R465	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
VR401	R01-4502-05	Variable resistor with switch 50kΩB
VR402	R12-1504-05	Semi-fixed resistor 2.2kΩB
VR403	R12-3033-05	Semi-fixed resistor 10kΩB
VR404	R12-5502-05	Semi-fixed resistor 100kΩB
VR405	R12-3035-05	Semi-fixed resistor 47kΩB
VR406	R12-3504-05	Semi-fixed resistor 47kΩB
CAPACITOR		
C401	CQ93M1H103K	Mylar 0.01μF ±10%
C402	CK45B1H332K	Ceramic 3300pF ±10%
C403,404	CK45D1H103M	Ceramic 0.01μF ±20%
C405	CE04W1A470	Electrolytic 47μF 10WV
C406,407	CK45D1H103M	Ceramic 0.01μF ±20%
C408	CE04W1A470	Electrolytic 47μF 10WV
C409	CE04BW1H010M	Electrolytic 1μF 50WV
C410	CE04W1A101	Electrolytic 100μF 10WV
C411	CQ93M1H472K	Mylar 4700pF ±10%
C412	CK45D1H103M	Ceramic 0.01μF ±20%
C413	CK45D1H222M	Ceramic 2200pF ±20%
C414,415	CK45D1H103J	Ceramic 0.01μF ±5%
C416	CC45CH1H050D	Ceramic 5pF ±0.5pF
C417~419	CK45D1H103M	Ceramic 0.01μF ±20%

Ref. No.	Parts No.	Description
C420	CC45CH2H010C	Ceramic 1pF ±0.25pF
C421	C90-0298-05	Semi-conductor ceramic 0.1μF +80%, −20%
C422~424	C91-0518-05	Oil 0.01μF 1.6kV
C425	CK45E3D102P	Ceramic 1000pF +100%, −0%
C426	CE04W2E010	Electrolytic 1μF 250WV
C427	CK45D2H103M	Ceramic 0.01μF ±20%
C429	C92-0518-05	Oil 0.01μF 1.6kV
C430	CQ93M1H154M	Mylar 0.15μF ±20%
C433,434	CK45D1H103M	Ceramic 0.01μF ±20%
C435~437	CE04W1A470	Electrolytic 47μF 10WV
C438	CE04W1C102	Electrolytic 1000μF 16WV
C439	CC45CH1H050D	Ceramic 5pF ±0.5pF
C440	CK45B1H220J	Ceramic 22pF ±5%
C441	C91-0509-05	Ceramic 0.1μF
C443	CC45CH1H680J	Ceramic 68pF ±5%
C447	CE04W1C331	Electrolytic 330μF 16WV
TC401	C05-0066-05	Ceramic trimmer 10pF
SEMICONDUCTOR		
IC401		IC RC733T
IC402		IC SN74LS00N
IC403		IC NJM78L05/A
Q401		FET 2SK30A(0)
Q402~405		Transistor 2SC1407(C)
Q406		FET 2SK30A(0)
Q407		Transistor 2SA838(C)
Q408~410		Transistor 2SC1407(C)
Q411~411		Transistor 2SC983(Y)
Q414,415		Transistor 2SC1407(C)
D401,402		Diode ISI555
D403		Zener diode WZ-050
D404		Diode ISS83
D405		Diode ISI555
D406~408		Diode W06C
D409		Zener diode WZ-050
MISCELLANEOUS		
—	A22-0809-04	Sub-panel
—	E23-0015-04	Grounding lug
—	E02-0127-05	IC socket
—	E23-0047-04	Terminal
P401	E40-0313-05	Connector 3P
P402	E40-0672-05	Connector 6P
P403	E40-0332-05	Connector 3P
P404	E40-0513-05	Connector 5P
P405	E40-0313-05	Connector 3P
P406	E40-0472-05	Connector 4P
P407	E40-0543-05	Connector 5P
P408	E40-0313-05	Connector 3P
P409	E40-0372-05	Connector 3P
J21	E31-0631-05	Lead wire with connector
—	F31-0602-04	Reinforcement plate
—	J25-2832-13	Printed circuit board

PARTS LIST

Ref. No.	Parts No.	Description
L401	L40-4791-02	Ferri-inductor 4.7μH
N401,402		Neon lamp NE-2
S401~403	S33-4501-15	Lever switch

VERTICAL UNIT (X73-1240-00)

Ref. No.	Parts No.	Description
	RESISTOR	
R101	RD14BB2E105J	Carbon 1MΩ ±5% 1/4W
R102	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R103	RN14BK2H9003F	Metal film 900kΩ ±1% 1/2W
R104	RN14BK2H9903F	Metal film 990kΩ ±1% 1/2W
R105	RN14BK2H9993F	Metal film 999kΩ ±1% 1/2W
R106	RN14BK2E1113F	Metal film 111kΩ ±1% 1/4W
R107	RN14BK2E1012F	Metal film 10.1kΩ ±1% 1/4W
R108	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R109	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R110	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R111,112	RN14BK2E5601F	Metal film 5.6kΩ ±1% 1/4W
R113	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R114	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R115	RN4BK2E4301F	Metal film 4.3kΩ ±1% 1/4W
R116	RN14BK2E5101F	Metal film 5.1KΩ ±1% 1/4w
R117	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R118,119	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R120	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R121,122	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R123	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R125	RN14BK2E6340F	Metal film 634Ω ±1% 1/4W
R126	RN14BK2E4700F	Metal film 470Ω ±1% 1/4W
R127	RN14BK2E68R0F	Metal film 68Ω ±1% 1/4W
R129	RN14BK2E1100F	Metal film 110Ω ±1% 1/4W
R130	RD14BB2E8R2J	Carbon 8.2Ω ±5% 1/4W
R131,132	RN14BK2E1200G	Metal film 120Ω ±2% 1/4W
R133	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R134,135	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R136	RN14BK2E6800G	Metal film 680Ω ±2% 1/4W
R139,140	RN14BK2E6801F	Metal film 6.8kΩ ±1% 1/4W
R141,142	RN14BK2E5600G	Metal film 560Ω ±2% 1/4W
R143,144	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R145	RN14BK2E6801G	Metal film 6.8kΩ ±2% 1/4W
R146,147	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R148,149	RN14BK2E2201G	Metal film 2.2kΩ ±2% 1/4W
R150,151	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R152	RN14BK2E2001F	Metal film 2kΩ ±1% 1/4W
R153,154	RN14BK2E5601G	Metal film 5.6kΩ ±2% 1/4W
R155	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R156	RN14BK2E5600G	Metal film 560Ω ±2% 1/4W
R157~160	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R161~162	RN14BK2E8201G	Metal film 8.2kΩ ±2% 1/4W
R163	RN14BK2E2700G	Metal film 270Ω ±2% 1/4W
R165,166	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R167	RN14BK2E6201G	Metal film 6.2kΩ ±2% 1/4W
R168	RN14BK2E3901G	Metal film 3.9kΩ ±2% 1/4W
R169	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R170	RD14BB2E272J	Carbon 2.7kΩ ±5% 1/4W
R171	RD14BB2E105J	Carbon 1MΩ ±5% 1/4W
R172	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R173	RN14BK2H9003F	Metal film 900kΩ ±1% 1/2W
R174	RN14BK2H9903F	Metal film 990kΩ ±1% 1/2W
R175	RN14BK2H9993F	Metal film 999kΩ ±1% 1/2W
R176	RN14BK2E1113F	Metal film 111kΩ ±1% 1/4W
R177	RN14BK2E1012F	Metal film 10.1kΩ ±1% 1/4W
R178	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R179	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R180	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R181,182	RN14B K2E5601F	Metal film 5.6kΩ ±1% 1/4W
R183	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R184	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R185	RN14BK2E4301F	Metal film 4.3kΩ ±1% 1/4W
R186	RN14BK2E5101F	Metal film 5.1kΩ ±1% 1/4W
R187	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R188,189	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R190	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R191,192	RN14BK2E2701F	Metal film 2.7kΩ ±1% 1/4W
R193	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R194	RN14BK2E6340F	Metal film 634Ω ±1% 1/4W
R196	RN14BK2E4700F	Metal film 470Ω ±1% 1/4W
R197	RN14BK2E68R0F	Metal film 68Ω ±1% 1/4W
R199	RN14BK2E1100F	Metal film 110Ω ±1% 1/4W
R200	RD14BB2E8R2J	Carbon 8.2Ω ±5% 1/4W
R201,202	RN14BK2E1200G	Metal film 120Ω ±2% 1/4W
R203	RN14BK2E1001F	Metal film 1kΩ ±1% 1/4W
R204,250	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R206	RN14BK2E6800G	Metal film 680Ω ±2% 1/4W
R209,210	RN14BK2E6801F	Metal film 6.8kΩ ±1% 1/4W
R211,212	RN14BK2E5600G	Metal film 560Ω ±2% 1/4W
R213,214	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R215	RN14BK2E6801G	Metal film 6.8kΩ ±2% 1/4W
R216,217	RD14BB2E470J	Carbon 47kΩ ±5% 1/4W
R218,219	RN14BK2E2201G	Metal film 2.2kΩ ±2% 1/4W
R220,221	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R222	RN14BK2E2001F	Metal film 2kΩ ±1% 1/4W
R223,224	RN14BK2E5601G	Metal film 5.6kΩ ±2% 1/4W
R225	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R226	RN14BK2E5600G	Metal film 560Ω ±2% 1/4W
R227~230	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R231,232	RN14BK2E8201G	Metal film 8.2kΩ ±2% 1/4W
R233	RN14BK2E2700G	Metal film 270Ω ±2% 1/4W
R235~238	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R239	RN14BK2E6201G	Metal film 6.2kΩ ±2% 1/4W
R240,241	RN14BK2E3901G	Metal film 3.9kΩ ±2% 1/4W
R242	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R243	RD14BB2E272J	Carbon 2.7kΩ ±5% 1/4W
R244~247	RN14BK2E2001G	Metal film 2kΩ ±2% 1/4W
R248~255	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R256,257	RD14BB2E681J	Carbon 680Ω ±5% 1/4W
R258	RN14BK2E1300F	Metal film 130Ω ±1% 1/4W
R261,263	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R264,265	RN14BK2E1801G	Metal film 1.8kΩ ±2% 1/4W
R266	RN14BK2E1001G	Metal film 1kΩ ±2% 1/4W
R268,269	RN14BK2E2401G	Metal film 2.4kΩ ±2% 1/4W

PARTS LIST

Ref. No.	Parts No.	Description
R270,271	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R272,273	RN14BK2E2700G	Metal film 270Ω ±2% 1/4W
R274~277	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R278,279	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R280	RD14BB2E153J	Carbon 15kΩ ±5% 1/4W
R281,282	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R284,285	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R288,289	RS14GB3D392J	Metal film 3.9kΩ ±5% /W
R290,291	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R292,293	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R294,295	RN14BK2E2701G	Metal film 2.7kΩ ±2% 1/4W
R296,297	RN4BK2E2201G	Metal film 2.2kΩ ±2% 1/4W
R298	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R299	RD14BB2E182J	Carbon 1.8kΩ ±5% 1/4W
VR101	R12-1030-05	Semi-fixed resistor 1kΩB
VR102	R12-0508-05	Semi-fixed resistor 470ΩB
VR103	R01-2508-05	Variable resistor 5kΩB
VR104	R01-0506-05	Variable resistor 500ΩB
VR105	R12-0058-05	Semi-fixed resistor 470ΩB
VR106	R12-1030-05	Semi-fixed resistor 1kΩB
VR107	R12-0508-05	Semi-fixed resistor 470ΩB
VR108	R01-2508-05	Variable resistor 5kΩB
VR109	R01-0504-05	Variable resistor with switch 500ΩB
VR110	R12-0058-05	Semi-fixed resistor 470ΩB
VR111	R12-0502-05	Semi-fixed resistor 100ΩB
CAPACITOR		
C101	C91-0501-05	Metal film 0.047μF ±10%
C102	CM93BD2A470J	Mica 47pF ±5%
C103	CM93BD2A471J	Mica 470pF ±5%
C104	CM93BD2A332J	Mica 3300pF ±5%
C105	C91-0503-05	Mylar 4700pF ±5%
C106,107	CK45D1H103M	Ceramic 0.01μF ±20%
C108	CC45CH1H030D	Ceramic 3pF ±0.5pF
C109	CC45CH1H470J	Ceramic 47pF ±5%
C110	CC45CH1H050D	Ceramic 5pF ±0.5pF
C111	CC45CH1H220J	Ceramic 22pF ±5%
C112	CC45CH1H120J	Ceramic 12pF ±5%
C113	CC45CH1H470J	Ceramic 47pF ±5%
C114	CE04W1C4R7	Electrolytic 4.7μF 16WV
C115~120	CK45D1H103M	Ceramic 0.01μF ±20%
C121	C91-0501-05	Metal film 0.047μF ±10%
C122	CM93BD2A470J	Mica 47pF ±5%
C123	CM93BD2A471J	Mica 470pF ±5%
C124	CM93BD2A332J	Mica 3300pF ±5%
C125	C91-0503-05	Mylar 4700pF ±5%
C126,127	CK45D1H103M	Ceramic 0.01μF ±20%
C128	CC45CH1H030D	Ceramic 3pF ±0.5pF
C129	CC45CH1H470J	Ceramic 47pF ±5%
C130	CC45CH1H050D	Ceramic 5pF ±0.5pF
C131	CC45CH1H220J	Ceramic 22pF ±5%
C132	CC45CH1H150J	Ceramic 15pF ±5%
C133	CC45CH1H470J	Ceramic 47pF ±5%
C134	CE04W1C4R7	Electrolytic 4.7μF 16WV
C135	CE04W1A470	Electrolytic 47μF 10WV
C136	CK45D1H103M	Ceramic 0.01μF ±20%

Ref. No.	Parts No.	Description
C137	CC45CH1H100D	Ceramic 10pF ±0.5pF
C138	CK45D1H103M	Ceramic 0.01μF ±20%
C139	CC45CH1H270J	Ceramic 27pF ±5%
C140	CC45CH1H050D	Ceramic 5pF ±0.5pF
C141~142	CK45D2H103M	Ceramic 0.01μF ±20%
C143	CK45D1H103M	Ceramic 0.01μF ±20%
C144	CE04W1C470	Electrolytic 47μF 16WV
C145	CK45D1H103M	Ceramic 0.01μF ±20%
C146	CE04W1C470	Electrolytic 47μF 16WV
C147	CK45D1H103M	Ceramic 0.01μF ±20%
C148	CC45CH1H050D	Ceramic 5pF ±0.5pF
C149	CK45D1H103M	Ceramic 0.01μF ±20%
C150	CC45CH1H050D	Ceramic 5pF ±0.5pF
C151	CC45CH1H180J	Ceramic 18pF ±5%
C152	CE04W1A470	Electrolytic 47μF 10WV
C153,154	C90-0298-05	Semi-conductor ceramic 0.1μF +80%, −20%
TC101~103	C05-0403-05	Ceramic trimmer 6pF
TC104~106	C05-0404-05	Ceramic trimmer 10pF
TC107~109	C05-0403-05	Ceramic trimmer 6pF
TC110~112	C05-0404-05	Ceramic trimmer 10pF
TC113,114	C05-0405-05	Ceramic trimmer 20pF
TC115	C05-0031-05	Ceramic trimmer 10pF
SEMICONDUCTOR		
IC101,102		IC SN74LS00N
Q101		FET (Dual) 2SK58-1 (M,N)
Q102		FET 2SK30A(O)
Q103~106		Transistor 2SC1047(C)
Q107,108		Transistor 2SC1359(C)
Q109,110		Transistor 2SA838(C)
Q111~118		Transistor 2SC1359(C)
Q119,120		Transistor 2SA838(C)
Q121		FET (Dual) 2SK58-1(C,N)
Q122		FET 2SK30A(O)
Q123~126		Transistor 2SC1047(C)
Q127,128		Transistor 2SC1359(C)
Q129,130		Transistor 2SA838(C)
Q131~138		Transistor 2SC1359(C)
Q139,140		Transistor 2SC1047(C)
Q141,142		Transistor 2SC1953(R)
Q144,145		Transistor 2SA914(R)
Q146,147		Transistor 2SC1953(R)
Q148		Transistor 2SC1359(C)
Q149		Transistor 2SA838(C)
Q150,151		Transistor 2SC1359(C)
Q152		Transistor 2SC838(C)
Q153,154		Transistor 2SC1359(C)
D101~106		Diode ISI555
D107~112		Diode ISI587
D113~116		Diode ISI555
D117,118		Zener diode WZ-061
D119~122		Diode ISI587

PARTS LIST

Ref. No.	Parts No.	Description
	MISCELLANEOUS	
—	A22-0807-03	Sub-panel (V)
—	E23-0015-04	Grounding lug
—	E23-0514-04	Grounding plate
—	E04-0251-05	BNC receptacle
—	E23-0047-04	Terminal
—	E23-0511-04	Grounding plate
P1	E40-0532-05	Connector 5P
P2	E40-0813-05	Connector 8P
—	F10-1523-04	Shielding plate
—	F11-0026-24	Shielding case
—	F11-0916-04	Shielding case
—	F11-0928-04	Shielding case (L)
—	F11-0929-04	Shielding case (L)
—	F20-0606-04	Insulating plate
—	J25-2830-02	Printed circuit board
L101,102	L40-4701-03	Ferri-inductor 47μH
L103~106	L40-1592-02	Ferri-inductor 1.5μH
L109	L40-4701-03	Ferri-inductor 47μH
S101	S32-4007-05	Lever switch
S102	S29-2505-25	Rotary switch with variable resistor
S103	S32-4007-05	Lever switch
S104	S29-2505-25	Rotary switch with variable resistor
S105	S37-2005-05	Lever switch

* POWER SUPPLY UNIT (X68-1200-00)

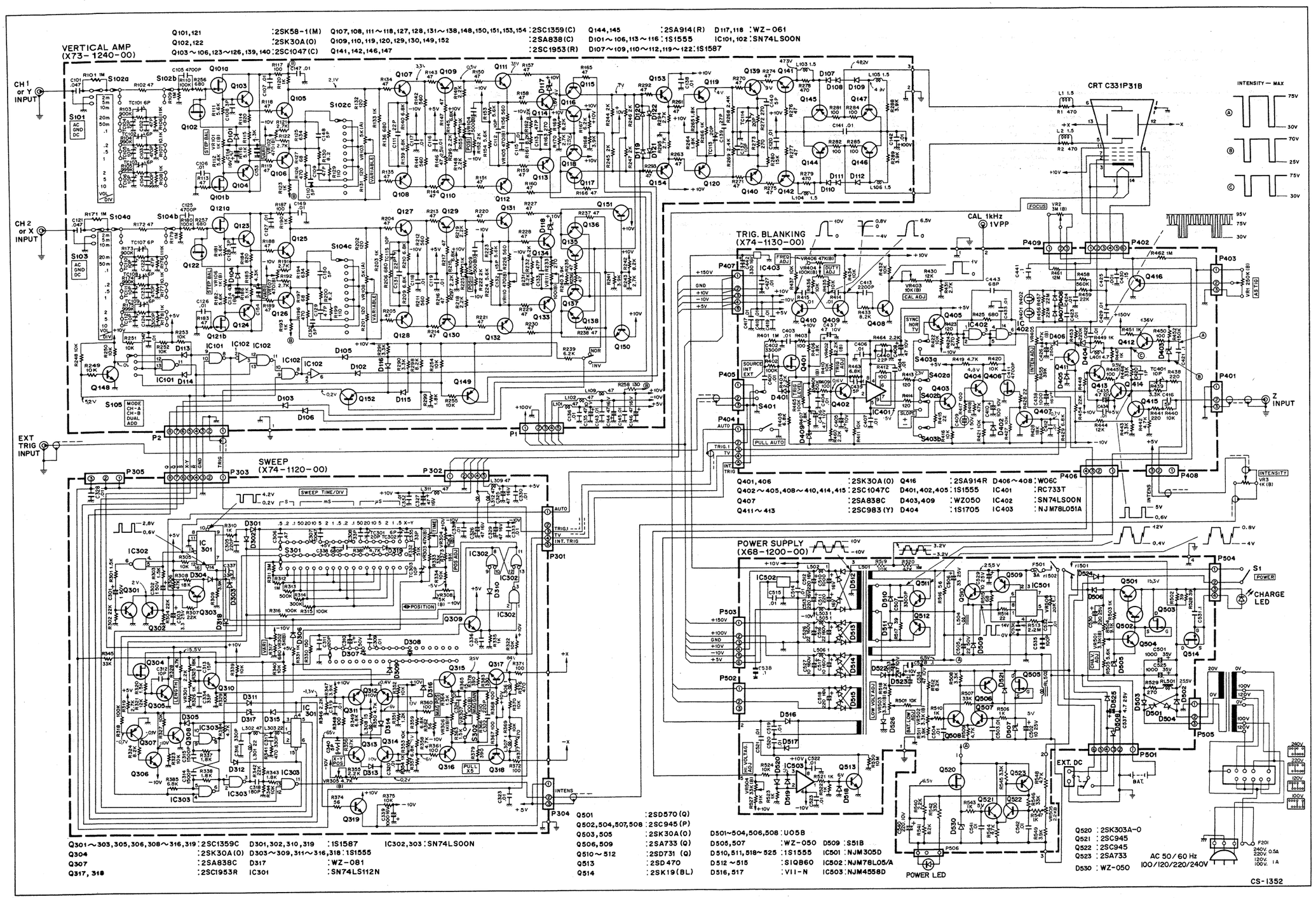
Ref. No.	Parts No.	Description
	RESISTOR	
R501	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R502	RS14GB3F390J	Metal film 39Ω ±5% 3W
R503	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R504	RN14BK2E9101G	Metal film 9.1kΩ ±2% 1/4W
R505	RN14BK2E5601G	Metal film 5.6kΩ ±2% 1/4W
R506	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R507	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R508	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R509	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R510	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R511	RN14BK2E3901G	Metal film 3.9kΩ ±2% 1/4W
R512	RN14BK2E8201G	Metal film 8.2kΩ ±2% 1/4W
R513	RC05GF2E225J	Solid 2.2MΩ ±5% 1/4W
R514	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R515	RD14BB2E680J	Carbon 68Ω ±5% 1/4W
R516	RS14GB3D560	Metal film 56Ω ±5% 2W
R517	RD14BB2E390J	Carbon 39Ω ±5% 1/4W
R518	RN14BK2E8201G	Metal film 8.2kΩ ±2% 1/4W
R521~523	RD14BB2E102J	Carbon 1KΩ ±5% 1/4W
R524	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R527	RN14BK2E9102G	Metal film 91kΩ ±2% 1/4W
R528	RS14GB3F390J	Metal film 39Ω ±5% 3W
R529	RS14GB3D271J	Metal film 270Ω ±5% 2W
R530	RD14BY2H106J	Carbon 10MΩ ±5% 1/2W
R540	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R541	RD14BBB2E822J	Carbon 8.2kΩ ±5% 1/4W
R542	RD14BB3E331J	Carbon 330Ω ±5% 1/4W
R543	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R544	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R545	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R546	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R547	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R548	RN14BK2E4701G	Carbon 4.7kΩ ±2% 1/4W
R549	RN14BK2E3901G	Carbon 3.9kΩ ±2% 1/4W
VR501~503	R12-1037-05	Semi-fixed resistor 3.3kΩB
VR504	R12-3502-05	Semi-fixed resistor 33kΩB
VR505	R12-1504-05	Semi-fixed resistor 2.2kΩB
VR506	R12-3506-05	Semi-fixed resistor 20kΩB
	CAPACITOR	
C501	CE04W1V102	Electrolytic 1000μF 35WV
C502	CE04W1E100	Electrolytic 10μF 25WV
C503,504	CK45D1H103M	Ceramic 0.01μF ±20%
C505	CE04W1C221	Electrolytic 220μF 16WV
C506	CE04W1E330	Electrolytic 33μF 25WV
C507	CQ93M1H332K	Mylar 3300pF ±10%
C510	CE04W1C102	Electrolytic 1000μF 16WV
C511~513	CE04W1C221	Electrolytic 220μF 16WV
C514,515	CK45D1H103M	Ceramic 0.01μF ±20%
C516	CE04W2C220	Electrolytic 22μF 160WV
C517	CE04W2C100	Electrolytic 10μF 160WV
C518	CE04W1C221	Electrolytic 220μF 16WV
C519~521	C91-0526-05	Polypropylene film 0.01μF
C522,523	CK45D1H103M	Ceramic 0.01μF ±20%
C525	CE04W1V102	Electrolytic 1000μF 35WV
C526	CE04W2C220	Electrolytic 22μF 160WV
C527	CE04W2C110	Electrolytic 11μF 160WV
C528	C90-0298-05	Semi-conductor ceramic 0.1μF+80%−20%
C529	CE04W1E100	Electrolytic 10μF 25WV
C530	CE04W1E221	Electrolytic 220μF 25WV
C531	C90-0298-05	Semi-conductor ceramic 0.1μF+80%−20%
C532	CC45DH1H103M	Ceramic 0.01μF ±20%
C533,534	CE04W1A470	Electrolytic 47μF 10WV
C535	CC45CH1H101J	Ceramic 100pF ±5%
C536	C90-0298-05	Semi-conductor ceramic 0.1μF+80%−20%
C537	CE04W1E4R7	Electrolytic 4.7μF 25WV
C540	CE04W1A221	Electrolytic 220μF 10WV
C541,542	CK45D1H103M	Ceramic 0.01μF ±20%
	SEMICONDUCTOR	
IC501		IC NJM305D
IC502		IC, Regulator NJM78L05/A
IC503		IC NJM4558D
Q501		Transistor 2SD570 (Q)
Q502		Transistor 2SC945 (P)
Q503		FET 2SK30A (O)

* Effective serial number from 482001 to 482100

PARTS LIST

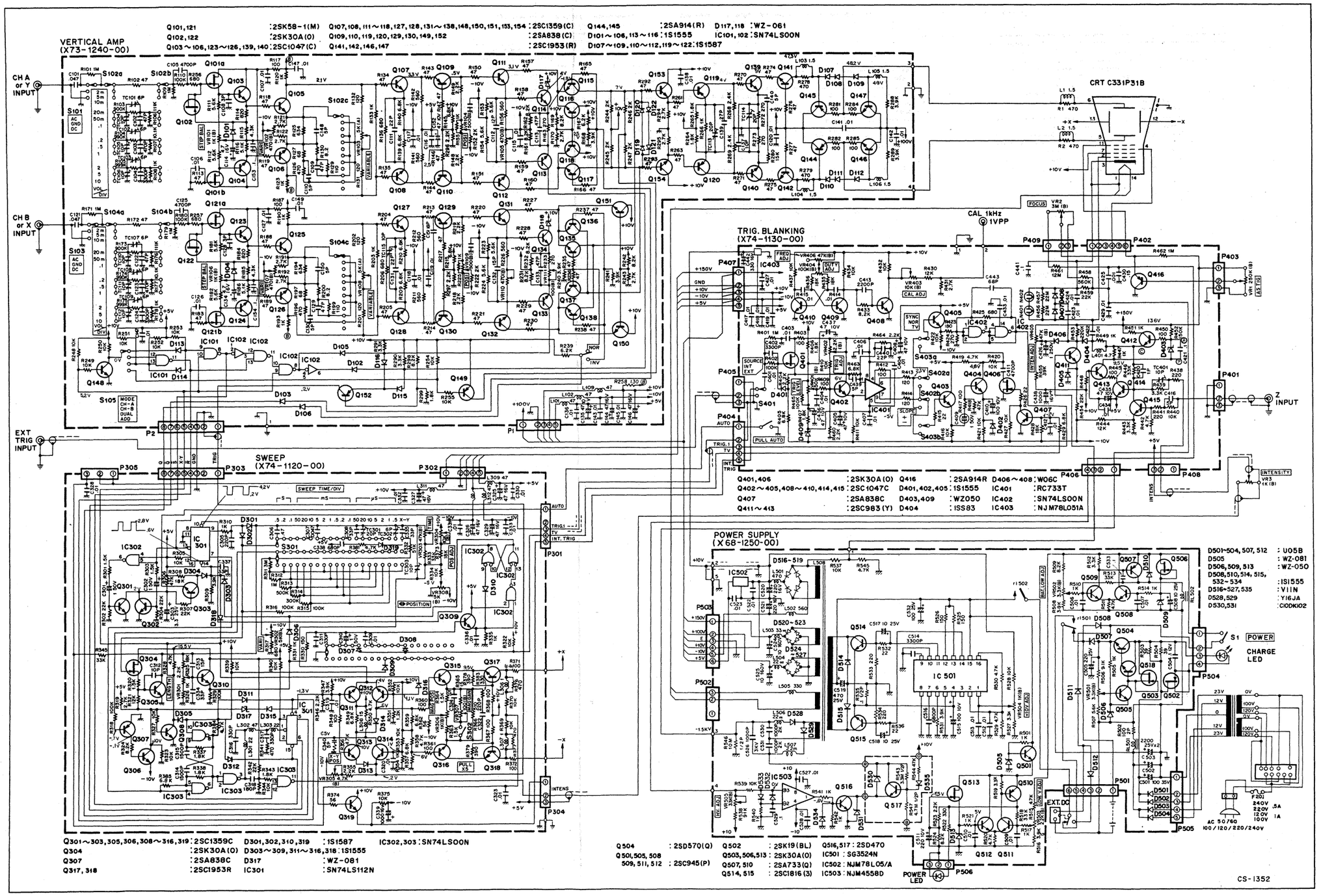
Ref. No.	Parts No.	Description
Q504		Transistor 2SC945 (P)
Q505		FET 2SK30A (O)
Q506		Transistor 2SA733 (Q)
Q507,508		Transistor 2SC945 (P)
Q509		Transistor 2SA733 (Q)
Q510~512		Transistor 2SD731 (Q)
Q513		Transistor 2SD470
Q514		FET 2SK19(BL)
Q520		FET 2KS30A (O)
Q521,522		Transistor 2SC945 (P)
Q523		Transistor 2SA733 (Q)
D501~504		Diode U05B
D505		Zener diode WZ-050
D506		Diode U05B
D507		Zener diode WZ-050
D508		Diode U05B
D509		Diode T51B
D510~511		Diode 1S1555
D512~515		Diode, Rectifier S1QB60
D516,517		Diode, High voltage V11-N
D518~526		Diode 1S1555
D530		Zener diode WZ-050
MISCELLANEOUS		
	E23-0046-04	Terminal ×4
J5	E31-0551-05	Lead wire with connector
J31	E31-0578-05	Lead wire with terminal
P501	E40-0632-05	Pin connector
P502	E40-0372-05	Pin connector
P503	E40-0632-05	Pin connector
P504	E40-0432-05	Pin connector
P505	E40-0332-05	Pin connector
P506	E40-0313-05	Pin connector
	F01-0815-04	Heat sink
F501	F05-3028-05	Fuse, 3A
	F11-0918-23	Shielding case (1)
	F11-0919-04	Shielding case(2)
	F12-0501-04	Flexible tube
	J25-2829-13	Printed circuit board
	J25-2837-04	Printed circuit board
	J42-0505-05	Bush
	J61-0047-05	Board support ×2
L501	L19-0404-05	DC-DC converter transformer
L502,503	L40-1025-04	Ferri-inductor 1mH
L504	L15-0401-05	Filter choke
L505,506	L40-1025-04	Ferri-inductor 1mH
RL501,502	S51-1505-05	Relay ×2

SCHEMATIC DIAGRAM



Effective serial number from 482001 to 482100

SCHEMATIC DIAGRAM



Effective serial number from 482101 up